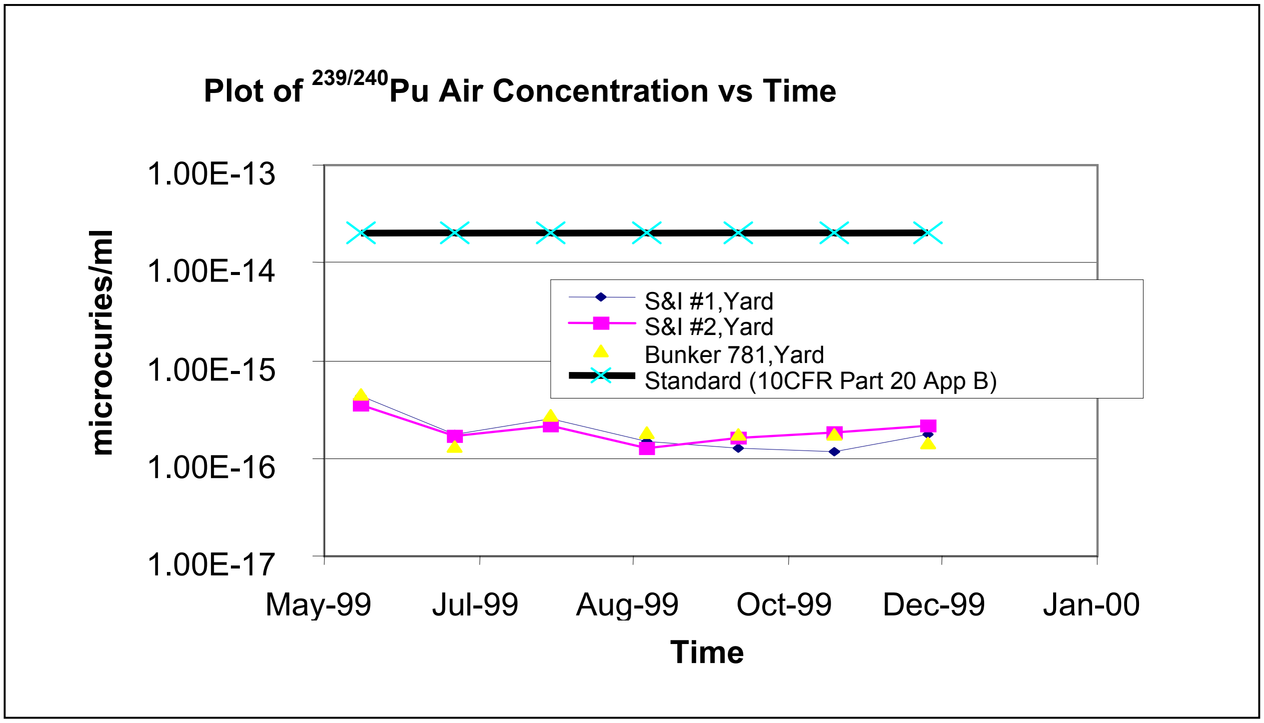
whales, the area is suspected to be a calving as well as a breeding ground. Three rare Cuvier's beaked whales (*Ziphius cavirostris*) were identified in the lagoon in the early 1990s; two of them appeared to be giving birth (Raytheon 1994).

Endangered Hawaiian monk seals (*Monachus schauinslandi*) have been observed at JA although JA is at the seal's range boundary (NOAA 2001). A monk seal gave birth to a female pup on Sand Island in 1969; no seals have been observed using the atoll as a breeding ground since that time. In 1984, nine monk seals were relocated from Laysan Island to JA and two more in 1998. Since 1990, there have been numerous well-documented sightings and one seal was seen consistently for several years since December 1991 (Raytheon 1994, USFWS 1999). No listed or designated critical habitat is known to exist at JA.

3.3 Air Quality

Very little data exists to characterize the air quality at JI. Air quality is generally viewed as extremely good. The dominant winds at JA are from the east and southeast. Air samplers operated at the western end of the RCA were in the predominant downwind direction. The Nuclear Regulatory Commission (NRC) does not regulate the plutonium or the plutonium oxide on JI since JA is not under their jurisdiction, but the DTRA uses the plutonium air standard for the general public as shown in Figure 1. As can be seen from Figure 1, the air concentrations on JI are well below the standard.

Figure 1 Plutonium Air Concentration on JI Over Time



3.4 Hydrology and Water Quality

The following provides a summary of the hydrology at JI. JI was originally a patch of coral sand in the Pacific Ocean. The soil on JI today typically consists of compacted crushed coral, hydraulically dredged from the surrounding lagoon during

JI's expansion efforts. Soil at JI has been reworked often, making it difficult to distinguish fill material from natural soil. Borings made by the U.S. Army Corps of Engineers (USACOE) show that sand, sandstone (beach rock), and loose coral make up the foundation of JI. This, along with the size, (3 km, or about 2 mi, in length, 0.8 km, or about 0.5 mi, wide) shape, and location of the southern reef, indicates that the entire southern reef complex is composed of wind- and sea- transported material that has been geologically "cemented" together. Most of JI's current 625 acres was created from coral line-dredge spoils on which over 300 buildings and facilities with approximately 130,064 m^2 (1.4 million ft^2) of space have been constructed.

Due to the high permeability of the soil, low rainfall, and high evaporation rates, there are no natural or permanent bodies of water on JI. The present topography is predominantly flat; the airport runway is the dominant island feature. Runoff occurs only during infrequent, high-intensity rainfall events. The runoff from the runway and other impermeable areas is primarily sheetflow that is channeled into trenches, ditches, and troughs. Approximately 55% precipitation runs off, and 45% percolates into the ground.

Groundwater at JI consists of an unconfined brackish lens of variable thickness, underlain by a region of saline water. Depth to groundwater varies from approximately 120 cm to 270 cm (4 ft to 9 ft) below ground surface. The percentage and location of fresh water runoff infiltrating permeable soils ultimately influences the thickness and lateral extent of the brackish lens within the island's subsurface. The brackish lens tends to thicken toward JI's mid-point.

4 CONTAMINANTS OF CONCERN

The BLUEGILL PRIME and STARFISH warheads primarily contained ^{239}Pu. Other isotopes, in decreasing abundance, ^{240}Pu, ^{241}Pu, ^{242}Pu and ^{238}Pu, are also present in missile warheads. From ^{241}Pu comes its decay product, ^{241}Am, which is used to detect both itself and plutonium via its gamma ray. Since there was no atomic yield, there are no fission products. Therefore, radioactive americium and plutonium oxides are the primary contaminants of concern. A discussion of the chemical properties of americium and plutonium is included below followed by a discussion of their radiological properties and health effects on humans.

4.1 Americium

The atomic number of americium is 95. It is part of the actinide series. Americium is most likely to exist in oxidation state III under most environmental conditions. As with plutonium, the chemical form is determined by the presence of oxidizing or reducing agents and complexing ligands in the host environmental media. Information on the environmental behavior of americium indicates that it is less strongly sorbed to soil than plutonium (Katz et al. 1986, Watters et al. 1980). The greater mobility and biological availability of americium is determined by the species formed by its hydrolysis. Americium is less readily hydrolyzed than plutonium, so it is more readily assimilated by plants (Katz et al. 1986). As with plutonium, the primary environmental route of transport of americium is through processes governing the distribution and movement of soil (Whicker and Schultz 1982).

Americium is not a biologically essential element, nor does it serve as an analogue for any other essential element. The International Committee on Radiation Protection (ICRP) Report 30 f1 value for ^{241}Am for both ingestion and inhalation is $5x10^{-4}$ in humans. The ICRP Report 30 defines the f1 value as “the fraction of the ingested compound of the element which is absorbed in the blood.”

4.1.1 Americium Uptake in Plants

Uptake of actinides by terrestrial plants from soil is generally low. Plant/soil concentration ratios for americium suggest a slightly greater uptake ratio than plutonium, on the order of 10^{-3}. It is important to note that there is considerable environmental variability in the uptake of americium, according to soil type and plant characteristics.

4.1.2 Summary

Americium’s chemical and physical properties limit its availability for human uptake and migration in the JA environment. Americium radionuclides are primarily alpha emitters and therefore are primarily an ingestion or inhalation hazard. The americium isotope of interest is ^{241}Am.

4.2 Plutonium

The atomic number of plutonium is 94. Plutonium is a dense, metallic element normally found as an oxide. Plutonium oxide is a solid under ordinary circumstances. It does not readily vaporize. It is less likely to vaporize, for example, than ordinary silica (quartz or beach sand). It melts at a temperature higher than quartz and is much less soluble in water than quartz (Condit 1993a). Plutonium is not routinely found in nature, except under extremely rare circumstances. Essentially all of the plutonium present on earth today can be attributed to human activities. Plutonium production and atmospheric nuclear weapons testing are the primary sources of plutonium in the environment (Perkins and Thomas 1980). Plutonium has several isotopes; all are radioactive. The most common ones are ^{239}Pu, ^{238}Pu, ^{240}Pu, ^{241}Pu, and ^{242}Pu. Plutonium is produced in reactors through neutron capture reactions. Once plutonium is separated and purified, it may be used in several ways - as fuel for nuclear reactors, as thermo-electric generators for spacecraft, for research, or for nuclear weapons. Non-nuclear accidents resulting in damage or destruction of nuclear weapons, such as the Palomares, Spain accident and the aborted missile launches at JA have also contributed to the presence of plutonium in the environment.

The chemical form of plutonium in the environment varies according to the source and the time since its release. Its potential movement through the ecosystem depends on its initial solubility in surface waters, interstitial waters of soils and sediments, and in the biological fluids of the exposed organisms. Solubility is a function of the chemical and physical form of the compound as well as properties of the system into which it is deposited. Regardless of the form of plutonium initially deposited in/on soils, sediments, or water, it is largely converted to the oxidation state IV. This oxidation state is extremely insoluble. Strong sorption of plutonium to soils and sediments results in its relative immobility in these media (Watters et al. 1980). This same tendency to form insoluble compounds typically results in its removal from aqueous systems (Katz et al. 1986).

Observations of the environmental behaviors of plutonium show that the concentration in soils and sediments are typically greater than in water or other environmental media by orders of magnitude. Plutonium exhibits multiple oxidation states, ranging from +3 to +7, four of which can coexist in acidic aqueous systems. Plutonium has a high ionic charge, which means that it tends to undergo hydrolysis, leading to the formation of polymers in systems with a pH > 2. The pH level, organic matter content, redox conditions, and mineralogy dictate the chemistry of plutonium in the soil system. For example, Nishita and Hamilton (1981) demonstrated that the solubility of Pu(IV) was dictated by the carbonate concentration in solution. Without carbonate, the pH level had to be raised to 8-10 to cause a corresponding increase in extractable plutonium. This was attributed to dissolution of alkali-soluble portions of organic matter. In general, under acidic ($pH < 3$) or alkaline ($pH > 7$) conditions and with a high percentage of organic matter, plutonium becomes more mobile in kaolinitic soils.

With little organic content, raising the pH level above 6 resulted in only the extraction of small amounts of material.

In general, the association of plutonium in the soil is largely with iron (Fe) and magnesium (Mg) oxides (~70-80%), and to a lesser extent (<10%) with the organic fraction of soil. The remainder (~20%) is in mineral lattice (Muller 1978). Plutonium's downward movement in soil is a relatively slow process (Bunzl et al. 1992, Muller 1978). Several mechanisms have been proposed to account for this movement, including chelation by naturally occurring soil organic constituents (Bondietti et al. 1976, Francis 1973), by earthworms and root channels (Litaor et al. 1994), by physical events such as soil cracking and frost heaving (Higley 1994), and by extreme events (Higley 1999). In long-term field studies, plutonium concentrations in soils remained relatively constant with depth over periods of several years. It is also known that plutonium is more mobile in coarser-textured soils and less so in peats and mucks (Federov et al. 1986). More than 99% of the plutonium inventory in most terrestrial ecosystems is found in the soil, particularly on or near the soil surface. Because it exists in a strongly adsorbed state on surface soils, the primary route of transport in the environment is through the processes governing the distribution and movement of soil (Whicker and Schultz 1982, Watters et al. 1980). The principal transport mechanisms for movement of soil are wind and water erosion.

Plutonium is not a biologically essential element, nor does it serve as an analogue for any other essential element. Because of this and the insoluble nature of plutonium, its passage through biological membranes and uptake into plant and animal tissues is normally very minor. Analyses of animals exposed to plutonium contaminated soils and vegetation have usually shown that the bulk of the plutonium resides in those tissues or organs directly exposed; e.g., pelts or skin, lungs, and gastrointestinal tracts (Bradley et al. 1977). Soil ingestion by animals results in the intake of plutonium associated with soil particles, but the majority of this material passes through the gut unabsorbed. The ^{239}Pu ICRP f1 value for both ingestion and inhalation is $1x10^{-5}$ in humans.

4.2.1 Plutonium Uptake in Plants

Several studies have been conducted on plutonium uptake by plants. Most of the work has focused on agriculturally significant crops. These studies examined uptake through surface deposition as well as root uptake. A literature review (Pimpl and Schüttelkopf 1981) detailed the magnitude of reported values of the concentration ratio (also called a transfer factor). This factor measures the ratio of activity in the plant to that in the surrounding soils. Values ranged from 10^{-9} to 10^{-3}, and depended on the soil type, the cation exchange capacity, and the soil pH level. Another significant factor was whether the original source was from atmospheric deposition onto plant surfaces or from root uptake. In one study of winter wheat (*Triticum aestivum*), it was reported that 70% of the contamination of grain was due directly to redeposition of contaminated dust during harvesting (McLeod et al. 1980). In a later study, the same author determined that varying crop rotations and liming the same contaminated soil resulted in decreased assimilation of plutonium by all crops.

Wind has been identified as a major source of movement in agricultural ecosystems as well (Pinder et al. 1990). As the surface soil mixes with deeper layers, wind erosion becomes less important as a distributive mechanism. However, other processes, such as uptake by plant roots, earthworm activity, and soil cracking, may increase in significance as the contamination moves into the root zone (Higley 1994, Higley 1999, Loch 1982).

4.2.2 Summary

Plutonium's chemical and physical properties limit its availability for human uptake and migration in the JA environment. Plutonium radionuclides are primarily alpha emitters and therefore are primarily an ingestion or inhalation hazard. The plutonium isotopes of interest are ^{238}Pu, ^{239}Pu, ^{240}Pu and ^{242}Pu.

4.3 Plutonium and Americium, Health Effects In Humans

Health effects from radiation exposure can be divided into two principal categories: nonstochastic and stochastic. Nonstochastic effects are those which have a threshold for occurrence and then increase in severity as the total dose increases. For example, cataract formation in the lens of the eye can be due to prolonged exposure to ionizing radiation. Another more severe example of nonstochastic impact is illness or ultimately, death after very high acute doses. Stochastic effects are random effects, which may or may not occur after radiation exposure. The likelihood of the effect's occurrence increases with increasing dose not the severity. The most familiar stochastic effect is cancer resulting from radiation exposure. The cancer is not made more severe by additional radiation, but the likelihood of developing cancer increases with increasing dose. On JA, the concentration of americium and/or americium oxides and plutonium and/or plutonium oxides are such that acute nonstochastic effects will not occur.

4.3.1 Americium Health Effects

According to the Department of Health and Human Services (PHS 2001), the only adverse health effects are due to the ionizing radiation decay emissions. Americium decays by both alpha and gamma radiation emission. The presence of gamma radiation allows efficient detection of americium. Since americium and plutonium do not separate in the JA environment (ORNL 2000b), it is possible to use the americium as a surrogate to determine the amount of both plutonium and americium. The gamma energy emitted from americium decay is 60 kiloelectron-volts (keV). This low energy gamma is emitted in only 35.9% of americium decays (Shlein 1992). The combination of low energy and low emission percentage make the external exposure dose on JA very low when compared to potential internal exposure through the inhalation pathway. Since plutonium is now six times as prevalent as americium (due to the radioactive decay process, see Annex B), americium is not the most important contaminant. As alpha emitters, the hazards of both americium and plutonium are essentially identical. For this reason, the focus will be on plutonium health effects.

4.3.2 Plutonium Health Effects

Under most conditions, the principal risk from plutonium is internal exposure through inhalation. Most of the radiation emitted by plutonium is in the form of alpha particles. Alpha particles are energetic, positively charged particles (helium nuclei) that rapidly lose energy when passing through matter. They are commonly emitted in the radioactive decay of the heaviest radioactive elements such as uranium and radium as well as by some artificially produced elements (plutonium and americium). Alpha particles do not penetrate tissue; however, they can cause damage over their short path. Fortunately, alpha particles are completely absorbed by the outer dead layer of the human skin (about 50 microns in tissue); therefore, alpha-emitting radioisotopes, such as plutonium and americium, are not a hazard outside the body. Alpha particles can also be stopped completely by a sheet of paper. However, alpha particles can be harmful if they are ingested or inhaled. External radiation from plutonium is negligible.

"To understand the toxicity of plutonium, it is important to understand the mechanisms by which it can produce health effects" (Sutcliffe et al. 1995, p. 2). The radiological hazards arise from the radiation dose delivered to various internal organs if it is taken into the body. The exposure pathways are ingestion and inhalation. Most studies to date have investigated the direct health effects of plutonium on animals such as dogs and rodents. Both acute and chronic effects have been shown in those various studies using both exposure pathways (PHS 1991).

According to Sutcliffe and others (1995), the acute lethal quantity for plutonium ingestion is about 0.5 g. An estimate of the acute toxic effect of plutonium is based on a calculation of the radiation dose it would deliver to the lining of the gastrointestinal tract. On JA, a person would have to ingest 0.2 million kilograms (kg) of coral sand from the "above" pile to ingest the lethal quantity of plutonium. For comparison, ingestion of less than 0.1 g of cyanide can cause sudden death (Lambertsen 1971). No radiogenic health effects have been observed below doses of 0.1 sievert (Sv). The lethal acute dose equivalent for most people from exposure to radiation is 4.5 Sv.

"The primary danger from plutonium is that small particles will become airborne and be inhaled. Particles that are too large to be inhaled fall to the ground, and only the smallest particles are carried very far from the source. Moreover, unless the particles are 'respirable' (smaller than about 3 micrometers in diameter), they are not inhaled into the depths of the lung, where they can be absorbed" (Sutcliffe et al. 1995, p. 3). Particles larger than 3 microns are filtered out either in the nasal or bronchial regions of the respiratory tract. For an aerosol of 1-micron median aerodynamic diameter, about 15% of inhaled plutonium dioxide

(PuO_2) would be retained in the deep lung with a retention half-life of about 1.4 years (NRC 1975, Table VI B-1). The principal hazard from exposure to lower concentrations of PuO_2 aerosols is an increased probability of lung cancer and other tissues to which the plutonium is transported, particularly the bone. A review of the risks associated with low radiation doses from inhaled ^{239}Pu indicate a fatal cancer risk of $8.45x10^{-7}$ per Bq inhaled (EPA 1999a).

The lethal quantity for plutonium inhalation is about 20 milligrams (mg) (0.02 g). The 20 mg would have to be within the optimal respirable size to cause death in about 30 days from pulmonary fibrosis or pulmonary edema. Assuming the coral was the optimal respirable size, which it is not, a person would have to inhale over 6000 kg of the "above" pile to deposit 20 mg of plutonium oxide in the lungs. Inhaled quantities significantly less than this (e.g. 0.08 mg of Pu) might not cause death from edema, but would be expected to cause death from cancer (Sutcliffe et al. 1995). "For perspective, an inhaled mass of about 0.0001 mg would increase the cancer mortality from about 200 in 1,000 (the risk of cancer mortality from all causes) to about 201.2 in 1,000. This risk increase corresponds to a decrease in life expectancy of about 15 days. For comparison, smoking a pack of cigarettes a day reduces life expectancy by about 2,250 days (more than six years)" (Sutcliffe et al. 1995, p. 2).

4.3.3 Summary

Ingestion and inhalation of small amounts of plutonium would increase the cancer mortality risk by a limited amount. If plutonium is ingested, it passes through the system with minimal absorption. Inhalation is the exposure route of concern, but is restricted by the body's natural defense system for particulate matter.

4.4 Radiological Control Area

The RCA is approximately 24 acres in size and encompasses two former missile launch emplacements and other buildings from the weapons testing period. The RCA also contains the metal debris, the concrete debris, the SGS, the "above" pile, and the "below" pile. The metal and concrete are assumed to be contaminated with plutonium oxide.

4.4.1 Metal Debris

The contaminated steel consists of sections of corrugated steel siding, sections of 1-cm (0.4-in) thick steel plate steel I-beams and U-channels, and other miscellaneous structural materials. The total weight of this debris is estimated to be 73 metric tons (MT) (80 short tons). Other debris includes steel frames and galvanized sheeting. This debris is estimated to be 145 MT (160 short tons). The total weight of steel is estimated to be 218 MT (240 short tons) (see Figures 2-5). The total metal debris also includes the SGS and a rock crusher.

Figure 2 Metal Debris

Figure 3 Metal Debris

Figure 4 Metal Debris

Figure 5 Metal Debris

4.4.2 Concrete Pile

The contaminated concrete originated from the foundation of the missile shelter, walkways, and other structures. The total volume for concrete is estimated to be 200 cubic meters (see Figures 6-8).

Figure 6 Concrete Pile

Figure 7 Concrete Pile

Figure 8 Concrete Pile

4.4.3 Coral Debris

The separation of the coral above and below the 13.5 pCi/g limit had several steps. The coral was excavated, crushed, sieved, and then sorted by the SGS. The result of this 8-year process is two different piles: the “above” pile and the “below” pile. Additional efforts were made to further reduce the volume of the “above” pile with the Bench Scale and Pilot Scale Technology Demonstration Project in 1996-1997. The DTRA solicited private industry to use innovative technology to lower the volume of the “above” pile. Unfortunately, private industry was unsuccessful in its demonstration attempts. The coral has been separated at the limit of current technology.

The estimated volume of the “above” pile is 45,000 cubic meters (Figure 9). The estimated concentration of the pile is 200 pCi/g of coral with a standard deviation of 92 pCi/g (Doane, personal communication 1998).

Figure 9 "Above" Pile and SGS Equipment

The estimated volume of the “below” pile is 120,000 cubic meters (Figure 10). Oak Ridge National Laboratory (ORNL) conducted a survey in 1999 of the “below” pile and found the average concentration to be 7.7 pCi/g of coral with a standard deviation of 12.9 pCi/g (ORNL 2000a).

Figure 10 "Below" Pile

5 OPERATIONAL AND FUTURE CONSIDERATIONS

5.1 Island Closure Schedule

The JACADS plant has finished demilitarization operations and is scheduled to complete final decontamination and decommissioning in 2003. JI's main mission over the past decade has been to support the chemical demilitarization effort. As decommissioning operations are completed, the island population, along with the logistical base, will begin to drawdown. Barge shipments, aircraft flights, and base operation support services will decrease.

5.2 Projected Land Use and Landowners

The final land use of the atoll has not been determined at this time. However, the USFWS of the U.S. Department of the Interior is expected to be JA's custodian. USFWS will likely continue to manage JA as a National Wildlife Refuge. The U.S. Department of the Interior has two likely options on the future management of JA: management as a permanent field station or management as a permanent field station with extended twin-engine operations (emergency landing area) (WHA 2001).

5.3 Land Use Controls

Once the remediation project is completed, the DTRA will recommend the landowners restrict digging on the remediation site. No other restrictions are necessary for JA from a radiological safety perspective. See Section 10 for long term monitoring requirements.

6 OPTIONS ANALYSIS

The process of analyzing each option has several steps. The first step is to apply the performance criteria to every option. Only those options that can meet the performance criteria are continued through the process. The options that pass the performance criteria then have the evaluation criteria applied. The evaluation criteria are used to rank order all the surviving options from the performance criteria screening. The final step is to compare the results of the evaluation criteria ranking and select the best option based on rank.

6.1 Performance Criteria

The following criteria are those standards that the options must meet to be considered for implementation: Protect Human Health and the Environment; Attain Cleanup Objectives; and Remediate New Sources.

6.1.1 Protect Human Health and the Environment

This performance criterion requires the remediation option to protect human health and protect the environment from excessive risk.

> **Standard**: The human health risk must be below $1x10^{-4}$ excess cancer risk (EPA regulatory development documents for an anticipated rulemaking to be codified at 40 CFR 196).

6.1.2 Attain Cleanup Objectives

The option must achieve and maintain protection of human health and the environment. In addition, it describes how existing and potential risks from pathways of concerns are eliminated, reduced or controlled.

> **Standard**: The DTRA formally recommended to the EPA that the cleanup standard for JA be 40 pCi/g. The EPA responded with "We acknowledge that the DTRA's proposed cleanup standard of 40 pCi/g is appropriate for the conditions at JA and within the EPA's accepted risk range. We are recommending that the DTRA continue to use the 13.5 pCi/g as a cleanup standard because it is As Low As Reasonably Achievable based upon the site specific conditions unique to Johnston Atoll" (2000, p. 3). The DTRA continues to use its voluntary cleanup standard for coral and will use the 13.5 pCi/g standard to establish the equivalent value of 168 pCi (fixed)/cm^2 for concrete surfaces (see Annex C). The option must explain how the risks, exposures or pathways are eliminated, reduced, or controlled and by what method(s).

6.1.3 Remediate New Sources

The remediation option must prevent any new releases that pose a risk to human health or the environment or the spread of contamination.

Standard: There will be no additional release of materials that would lead to excessive human health or environmental risk on JA.

6.2 Evaluation Criteria

Evaluation Criteria are used to evaluate all the surviving options from the performance criteria screening (see sections 7.6 and 8.10 for the comparisons). They are Long-Term Effectiveness, Reduction of Toxicity, Mobility, or Volume, Short-Term Effectiveness, and Implementability.

6.2.1 Long-Term Effectiveness

This "is the ability of any remedial approach to provide adequate protection of human health and the environment over the long-term" (EPA 1999b, p. 15).

This criterion is evaluated as follows:

Highly certain to be reliable for greater than 1,000 years and assigned a value of 4.
Highly certain to be reliable for 100-1,000 years and assigned a value of 3.
Highly certain to be reliable for 30-100 years and assigned a value of 2.
Highly certain to be reliable for approximately 30 years and assigned a value of 1.
Likely to be reliable for less than 30 years and assigned a value of 0.

6.2.2 Reduction of Toxicity, Mobility or Volume

This "is directly related to the concept of Long-Term reliability of the remedies" (EPA 1999b, p15). As a general goal, remedies that treat toxicity, mobility and/or volume are preferred over containment options. However, it is impossible to remove the radioactive toxicity of radionuclides or to artificially change the volume of the radionuclides. Only the natural decay of the material will change the toxicity or volume. As previously discussed, unsuccessful attempts to reduce the total volume of the "above" pile were made (see section 4.4.3). Therefore, this criterion will be limited to the discussion of how each option affects the mobility of the contaminants. This will address how much the option reduces the mobility for human exposure and the potential for environmental effects, thus a means of achieving the broader goal of reducing the risk to acceptable levels (EPA 1999b, 2001). A separate evaluation for human exposure and environmental effects will be made; both measurements are qualitative in nature and will be totaled for comparison purposes. If however, the option increases the total volume of contaminated material, then the option will be evaluated as less beneficial to the environment and scored 1 less than the following scores.

This criterion is evaluated as follows:

Elimination of mobility and assigned a value of 4.
Significant reduction of mobility and assigned a value of 3.
Moderate reduction of mobility and assigned a value of 2
Minimum reduction of mobility and assigned a value of 1.
No reduction of mobility and assigned a value of 0.

6.2.3 Short-Term Effectiveness

This addresses factors such as the implementation risks, "the magnitude of reduction of existing risk, and time until full protection is achieved" (EPA 1991, p. 16). This determines whether the execution of the option poses a greater risk than the option itself. The measurements are qualitative in nature.

This criterion is evaluated as follows:

It is effective and assigned a value of 4.
It is effective, but poses additional minimal risk and is assigned a value of 3.
It is effective, but introduces minimal new risks and is assigned a value of 2.
It is effective, but introduces significant new risks and is assigned a value of 1.
It is not effective and assigned a value of 0.

The determination between minimal risks and significant risks will be based on a risk assessment.

6.2.4 Implementability

This addresses the operational (time and cost) and the logistical (practicality) requirements of executing the option. "This criterion considers the ease of implementing the remedy in terms of construction and operation, and the availability of services and materials required to implement the alternative. … In addition, administrative feasibility, which includes activities that need to be coordinated with other offices and agencies (e.g., obtaining permits for off-site activities or rights-of-way for construction), should be addressed when analyzing this criterion" (EPA 2001, p. 3-9). Implementability estimates are based on estimates made by the DTRA engineering staff, experience with contractor performance and contractor cost proposals. These will be evaluated by comparing estimated expenses in the following categories:

Time: How long is the remediation option expected to take to execute?
Costs: What is the expected cost of the remediation option, and does it make fiscal sense?
Practicality: Is the remediation option practical to achieve at JA? This sub-criterion takes into account the remoteness of the islands and its resources.

Once the estimates are made, each option will be compared to the other options and a rank order score will be assigned. The shortest time is best, the smallest cost is best, and being practical is better than not being practical.

See sections 7.6 and 8.10 for the comparisons.

7 METAL AND CONCRETE DEBRIS DESCRIPTION

The metal and concrete debris (see Figures 2 - 8) have only limited surface contamination. The term limited is used for two reasons. The first, the concrete was intact at the time of the accident. Since 1963, the concrete has been broken into more manageable pieces, which exposed surfaces originally protected from the accidents. Today there is a larger concrete surface area than there was in 1963. The second reason for limited surface contamination is the possible cleansing effects of almost 40 years of weathering. Options for their final disposition are: 1) scrap metal dealer (metal debris only) and then island riprap for the concrete; 2) shipment to an off-island radioactive waste disposal facility for either or both; 3) landfill on JI for either or both; or 4) no action for either or both.

7.1 Option 1: Scrap Metal Dealer and Island Riprap or Reef Building for the Concrete

This option has two separate parts. First, a scrap metal dealer would be asked to take the metal debris for recycling. Second, the concrete would be used on JA as riprap. The concrete pile would be broken into more manageable pieces (with explosives, jackhammers, or heavy equipment). The concrete would be radiologically surveyed for release at 168 pCi/cm^2 (fixed) (see Annex C). The concrete that passed the survey would then be taken outside the RCA and used to reinforce the existing seawalls on JI or for reef building if a USACOE permit can be obtained. Any concrete that failed the survey or any concrete that was unable to be reduced to a manageable size would remain inside the RCA for action under other options.

7.2 Option 2: Shipment to an Off-Island Radioactive Waste Facility

This option would require either or both the metal and concrete debris to be dismantled into small enough pieces for transport to a disposal site in the continental U.S. A complete radiological characterization survey would be required to characterize the activity being shipped. The level of the characterization survey would be completely dependent upon the final destination; however, it would be expected to include, but not be limited to, surface scans and swipe tests. Potential sites are the Envirocare facility in Utah and the U.S. Department of Energy's (DOE) Nevada Test Site (NTS) in Nevada. The debris would be shipped from JI via Hawaii to a major port on the west coast of the continental U.S. and transported from there to the facility.

7.3 Option 3: Landfill on JA

The option would move the metal and concrete debris from their present locations to a cell for burial inside the RCA or allow for burial in place (see Figure 11). This option would not require a radiological survey since the debris piles would not leave the RCA. The metal and concrete would then be covered with coral from the “below” pile. The covering material would be brought into the landfill cells in lifts, compacted, and graded to achieve a 10:1 slope to allow for proper water drainage and prevent any surface ponding, and to minimize water intrusion (see Figures 11-12).

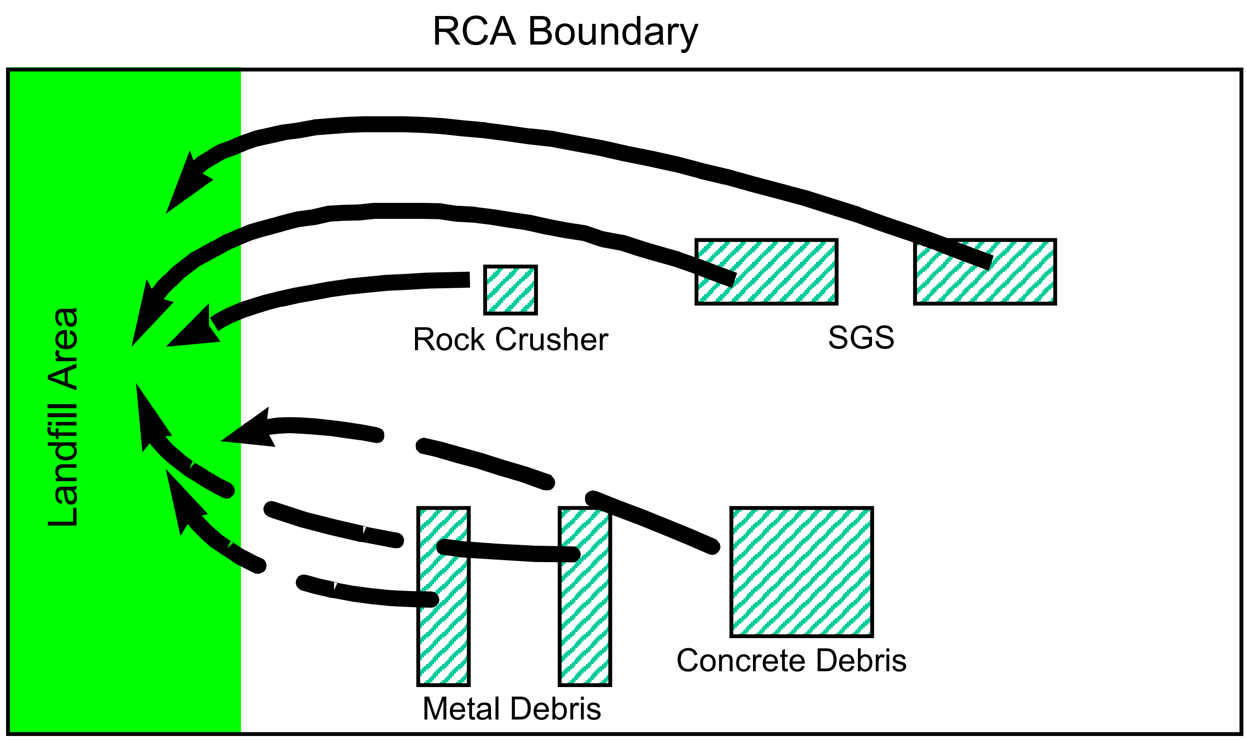


Figure 11 Top View of the Landfill (not to scale)

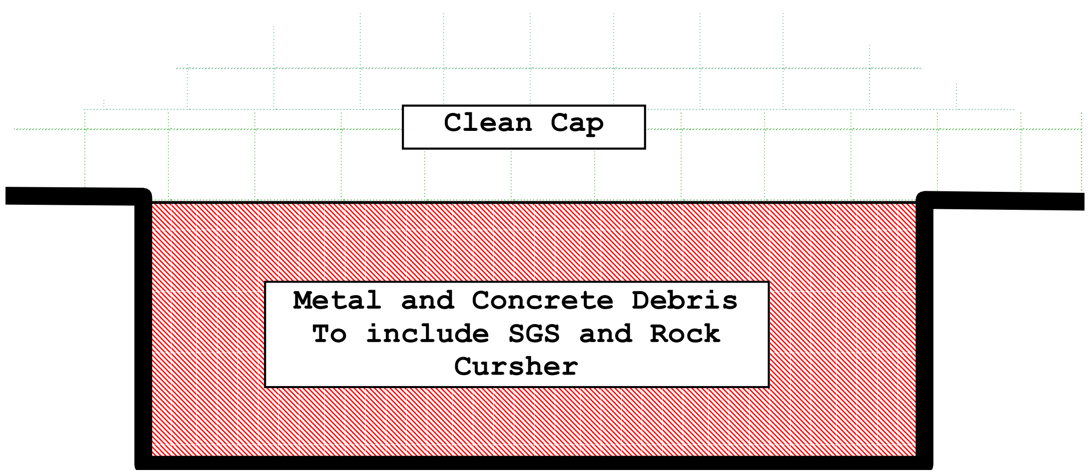


Figure 12 Side View of Landfill (not to scale)

7.4 Option 4: No Action

This option would be to leave the piles and the SGS equipment as they are (Figures 2 - 9).

7.5 Application Of Performance Criteria to the Metal And Concrete Debris Options

The following is a discussion of the application of the performance criteria. Table 1 below summarizes the results of applying the performance criteria to each option.

7.5.1 Option 1: Scrap Metal Dealer for the Metal Debris and Island Riprap or Reef Building for the Concrete

Protect Human Health and the Environment

Any radioactive material would have been deposited at the time of the 1962 aborts and during the subsequent movement to its present location. Since then, the metal has corroded and thereby encapsulated the radioactive material. While this corrosion is serving as a temporary shield (until the metal completely rusts and falls away), it is expected that a scrap metal dealer would melt the metal for other uses. This melting could free any remaining radioactive material from the existing metal and allow the radioactive material to be released onto the smelting equipment. The newly smelted material could contain any of the remaining radioactive material. Since the plutonium and americium emit only alpha particles and low-energy gamma rays, the new material would shield the radiation from any particles that are not directly on the new surface of the metal. The concentration would depend upon the volume and mass of the new material. The human exposure pathways would then be a function of the end use of the new material. Since the final use is unknown, this option fails this criterion.

The concrete that did not pass the radiological survey standard (168 pCi/cm^2 (fixed)) would not be eligible for use in this option. This screening standard has the potential to allow for a small amount of radioactive material to remain on the concrete. The interior concrete volume would be free from radioactivity since the outer layer protected it. If the concrete were used for riprap material, the surface of the contaminated concrete would be subject to wave action and erosion of the concrete surface and potential release to the environment. Once the surface layer of the concrete containing any radioactive material is eroded, no further plutonium could be released since it only exists on the surface of the concrete. The amount of additional radioactive material released into the environment would be small compared to the estimated amount of material deposited into the lagoon (Annex A). This option removes any radioactive material on the concrete from any potential human exposure since the primary exposure route is inhalation and the concrete would be under water. This option meets this criterion based on the equality of the recommended 13.5 pCi/g soil screening level and the 168 pCi/cm^2 (fixed) concrete level.

Attain Cleanup Objectives

The acceptance and subsequent off-island transport by a scrap metal dealer would achieve the cleanup objectives by removing all identified radioactive material from JA. This must be tempered with the fact that any radioactive material would be moved to another location. The option meets this criterion.

The equality of the recommended 13.5 pCi/g soil screening level to the 168 pCi/cm^2 (fixed) concrete level removes any difference between the soil and concrete on top of the soil. This option eliminates the primary human exposure route, inhalation, by the submergence of the concrete in the lagoon riprap. This option meets this criterion.

Remediate New Sources

The movement of the metal pile to an uncontrolled area (scrap metal dealer) could potentially contaminate other locations as discussed above. This option does not meet this criterion.

The potential releases from the concrete into the lagoon do not pose a significant risk when compared to the amount estimated to be currently in the lagoon (DTRA 2001b Annex A). The DTRA does not expect the pile to have much concrete exceeding the 168 pCi/cm^2 (fixed) standard after 30 years of weathering, but this would have to be verified by a radiological survey before moving the concrete into the lagoon. This option meets this criterion.

7.5.2 Option 2: Shipment to an Off-Island Radioactive Waste Facility

This option could apply to the metal and to either the entire contents of the concrete pile or some fraction thereof. This option allows for flexibility in execution.

Protect Human Health and the Environment

The movement of the radioactive material would, by the transportation requirements, limit human exposure. A complete radiological characterization survey would be required to define the activity of the material being shipped. By disposal in a radioactive waste facility, the radioactive material would be isolated and human health and the JA environment would be protected. This option meets this criterion. This would, however, only shift the potential exposure risk to the facility elsewhere in the U.S. or any point on the shipment route. Nevertheless, this option meets this criterion.

Attain Cleanup Objectives

By removing the debris piles either in their entirety or the contaminated portion, cleanup objectives will be met by eliminating both the exposure pathway and the source term. This option would meet this criterion.

Remediate New Sources

This option would remove the radioactive material from JA as a potential new source for release (i.e., the material presently locked in the metal and any surface contamination on the concrete). This option meets this criterion.

7.5.3 Option 3: Landfill on JA

This option can apply to the metal debris and to either all or part of the concrete debris. This allows for flexibility in execution.

Protect Human Health and the Environment

The placement of the metal and concrete debris inside a landfill would isolate it from human exposure and restrict its release to the environment. This option meets this criterion.

Attain Cleanup Objectives

This option eliminates the primary human exposure route, inhalation, by the burial of the concrete in the landfill. This option meets this criterion.

Remediate New Sources

The landfill would slow the potential degradation of the metal and concrete debris, thereby slowing any potential release of any plutonium oxide from the metal or concrete. The chemical and physical properties of the plutonium oxide (melting point, insolubility in water, particle absorption tendencies (ONRL 2000a, Wolf et al. 1995) combine to restrict the spread of contamination by locking the material into the landfill. This option meets this criterion.

7.5.4 Option 4: No Action

Protect Human Health and the Environment

Currently, the metal and concrete debris are not a radiological risk but are subject to weathering and corrosion. As the metal continues to corrode and decay, the radioactive material could potentially be released along with corrosion products; however, the radioactive material would complex with the metal and the total particle size would not fall into the respirable range (Ristvet 2000). This fact should be compared to the air concentration data presented in Figure 1. Historically the air concentrations of plutonium are below the allowable general-public limits (10 CFR Part 20). This option meets this criterion.

Attain Cleanup Standards

This option does not eliminate, reduce, or control the present release rate of material from the debris. This option fails this criterion.

Remediate New Sources

Additional radioactive material may be made available to the environment as the metal corrodes and the concrete weathers in the JA environment. This must be tempered with the historical air sampling results taken directly downwind of the RCA which show no air concentrations above allowable limits (see Figure 1). Therefore, the amount of material added to the air is expected to be negligible but could be viewed as additional material. This option fails this criterion.

Table 1 Performance Criteria Summary for the Metal and Concrete Options

	Performance Criteria			
Option	Protect Human Health and the Environment	Attain Cleanup Objectives	Remediate New Sources	Survive
1: Scrap Metal Dealer	No	Yes	No	No
1: Island Riprap or Reef-Building for the Concrete	Yes	Yes	Yes (for released concrete)	Yes
2: Shipment to an Off-Island Radioactive Waste Facility	Yes	Yes	Yes	Yes
3: Landfill on JA	Yes	Yes	Yes	Yes
4: No Action	Yes	No	No	No

7.6 Application of Evaluation Criteria for Surviving Options

7.6.1 Option 1: Island Riprap or Reef-Building for the Concrete

Long-Term Effectiveness Score: 1

Weathering of the concrete surface by wave action will ultimately release any remaining surface-held radioactive material below 168 pCi/cm^2 (fixed). The expected lifetime of concrete that is subjected to ocean wave action would be on the order of 30 years. The option is evaluated to be highly certain to be reliable for approximately 30 years and therefore assigned a value of 1.

Reduction of Toxicity, Mobility, or Volume Score: 4, 1

The placement of concrete in the marine environment would eliminate the inhalation exposure pathway for humans but would allow any remaining, post-survey radioactive material to be available for release into the environment over the estimated lifetime of the concrete (30 years). This option is evaluated as eliminating mobility for humans with a value of 4 and minimum reduction of mobility in the environment, and assigned a value of 1.

Short-Term Effectiveness: 2

This option requires the use of explosives, jackhammers, or other heavy equipment (such as an excavator with hydraulic shears) to reduce the larger concrete pieces to a size that is manageable by the existing transportation equipment on JI. The reinforcing bar (rebar) would also have to be cut by either an excavator with a set of hydraulic shears or personnel with oxy-acetylene torches. The dismantling of the metal and concrete may resuspend radioactive material because of the reduction process. This risk can be controlled with the application of respiratory protection. The risks in this operation are commensurate with similar construction tasks. Since this option introduces new risks, it is assigned a value of 2.

Implementability: See below

Time: The estimated time for this option is 10 weeks after a permit is granted.

Cost: The cost for this option is estimated at $385,800. See Annex D for cost details.

Practicality: This reef-building effort cannot be accomplished with the equipment currently on JI. The reduction of the concrete to a more manageable size and the transportation of the concrete to the final reef building site require off-island equipment. A vessel capable of handling and placing large pieces of concrete would be required for reef building. The USACOE has indicated that seawall reinforcement efforts would not likely succeed (Draft EA 2001) and the added time involved with waiting for the possible permit to be approved also makes this option less practical. These issues make this option not practical for JA.

7.6.2 Option 2: Shipment to an Off-Island Radioactive Waste Facility for the Metal and/or the Concrete

Long-Term Effectiveness: 4

The isolation of the metal and concrete in a facility in the continental U.S. would isolate the material from human exposure and eliminate the spread of contamination on JI. This option is evaluated as being highly certain for greater than 1,000 years since the material would be removed from JA. A value of 4 is assigned. This would, however only shift any potential risk exposure to the facility in the continental U.S. or any point on the shipment route.

Reduction of Toxicity, Mobility, or Volume: 4, 4

The isolation of the metal and concrete in a facility in the continental U.S. would eliminate the mobility of the radioactive material via the shipping requirements and the transport off of JI. The option is evaluated as eliminating the mobility on JI and assigned a value of 4 for both humans and the environment on JI.

Short-Term Effectiveness: 1

The metal would have to be cut into small enough pieces for placement in a shipping container. This would require either an excavator with a set of hydraulic shears or personnel with oxy-acetylene torches. The concrete would also have to be reduced to small enough pieces to fit inside a shipping container. This process would require either explosives, an excavator with a hydraulic hammer, or a large crew with jackhammers. A crew with oxy-acetylene torches would also be required to cut the rebar present in the concrete. The dismantling of the metal and concrete may re-suspend radioactive material because of the shipment preparation process. This risk can be controlled with the application of respiratory protection for the workers. The other physical risks are those commensurate with operations of this type. The transportation risks can be quantified using the Sandia National Laboratory Transportation System Analysis Department's Value of accident probability per shipment per mile of $2.5x10^{-6}$ (Masey, personal communication 1999). The number of shipments is calculated using two 20-ft dry cargo containers. Table 2 shows the estimated probability of a highway accident for each potential disposal site (NTS and Envirocare).

Table 2 Estimated Number of Highway Accidents for Metal and Concrete Shipments

		Number of Estimated Highway Accidents	
Item	Estimated Number of Truck Shipments	NTS Site	Envirocare Site
Concrete	10	8.53E-03	1.83E-02
Metal	122	1.08E-01	2.31E-01
	Totals:	**1.16E-01**	**2.49E-01**

Since this option introduces new risk on JI and additional risks to populations outside JA, the option is assigned a value of 1.

Implementability: See below

Time: The time required to complete this option is 46 weeks.

Cost: The costs for this option include: 1) capital costs of the heavy equipment (excavator); 2) transportation costs of the heavy equipment combined with the transportation to the remote location; 3) decontamination of the equipment after the work is completed; 4) shipping costs to the commercial site; and 5) disposal fees. The projected cost for this option is between $6,481,800-6,877,300. The range is dependent upon the amount of concrete shipped (see Annex D for cost details).

Practicality: The effort required to ship the equipment on and off the island is significant. The gain in protection is minimal. This makes this option not practical for JA.

7.6.3 Option 3: Landfill on JI

Long-Term Effectiveness: 3

Leaving the metal and concrete on JI would isolate the material from human exposure by covering it with a coral cap. As long as the cap material remains in place, there is no method (short of human re-intervention or catastrophic natural event such as a volcanic eruption, earthquake, tsunami, or sea-level rise) for the material to move. The chemistry of PuO_2 prevents it from significantly moving into solution in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). The portion of the seawall surrounding JI that is closest to the RCA is not subject to intense wave action since the waves run parallel to the RCA. This is the least affected portion of the entire seawall. These facts lead to an evaluation of highly certain to be reliable for 100-1,000 years and an assigned value of 3.

Reduction of Toxicity, Mobility, or Volume: 3, 3

The isolation of the metal and concrete in a landfill on JI would eliminate the mobility of the radioactive material by confining it within the coral matrix. Since it significantly reduces the mobility, it is assigned a value of 3 for both humans and the environment on JI.

Short-Term Effectiveness: 2

The landfill construction process may re-suspend radioactive material. This risk can be controlled with the application of respiratory protection for the workers. The other physical risks are those commensurate with operations of this type (use of heavy equipment, cutting, jackhammers, etc.) This option introduces additional minimal risk by resuspension of radioactive material and assigned a value of 2.

Implementability: See below

Time: The estimated time to move the metal/concrete debris and place the clean cap is 40 weeks.

Cost: The estimated cost for this option is $1,420,000. See Annex D for specific cost analysis.

Practicality: Moving the metal and concrete debris could be done with the heavy equipment onsite, since it was placed in its current location with on-island equipment and is practical for JA.

7.6.4 Evaluation Criteria Summary of Metal and Concrete Options

Table 3 Metal and Concrete Evaluation Summary

Option	Long-Term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability		
				Time	Cost ($)	Practical for JA
1: Island Riprap or Reef Building for the Concrete Only	Highly certain for 30 years **(1)**	1) Elimination of mobility for humans **(4)** 2) Allows for potential release to environment **(1)**	Effective but introduces new minimal risks (**2**)	10 weeks	$385,800 concrete only	No
2: Shipment to an Off-Island Radioactive Waste Facility	Highly certain for greater than 1,000 years **(4)**	Elimination of mobility for humans and the JA environment **(4)** (*transfer risk to another location)*	Effective but introduces significant new risks (**1**)	46 weeks	$6,481,800-$6,877,300 ($581,800-$977,300 concrete only)	No
3: Landfill on JI	Highly certain for 100-1,000 years **(3)**	Significant reduction of mobility for humans and the JA environment **(3)**	Effective but introduces new minimal risks (**2**)	40 weeks	$1,420,000 ($520,000 concrete only)	Yes

7.6.5 Analysis of the Evaluation Criteria

A ranking system was used to evaluate these criteria. The best score for each criterion was assigned a rank of 1. The worst was assigned a rank of 3. If two options had the same evaluation, the two ranks were averaged and the average assigned to each option. All the criteria were weighted equally. The ranks were then summed to determine the best option (the one having the lowest rank summation). Table 4 below summarizes the results of this analysis.

Table 4

Metal Option Analysis and Ranking

Option	Long-Term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability			Total Score
				Time	Cost	Practicality for JA	
2: Shipment to an Off-Island Radioactive Waste Facility	1	1	2	2	2	2	**10**
3: Landfill on JI	2	2	1	1	1	1	**8**
Concrete Option Analysis and Ranking							
1: Island Riprap or Reef Building for the Concrete Only	3	3	1.5	1	1	2.5	**12**
2: Shipment to an Off-Island Radioactive Waste Facility	1	1	3	3	3	2.5	**12.5**
3: Landfill on JI	2	2	1.5	2	2	1	**10.5**

7.6.6 Evaluation Criteria Summary

Option 3, Landfill on JI, is the best choice after evaluating each option with the evaluation criteria. The metal debris has two options, shipment off the island

(Option 2) or landfill on the island (Option 3). The difference in the total scores is 2 points. Two major differences separate the two options. The first occurs in the Short-Term Effectiveness criterion as the projected number of highway accidents during the transportation to the possible disposal sites adds additional risk to option 2. Although the number of accidents is projected to be less than one, the potential consequences from a radioactive material spill are significant. These consequences include but are not limited to 1) another cleanup site for the DTRA; 2) potential for public exposure (albeit at extremely low levels); and 3) possible litigation. The second difference is in the implementability. The projected cost difference is large, on the order of several millions of dollars between the on-site landfill and shipment off-island, option 3 can be completed in less time than option 2, and only option 3 is practical with the JA infrastructure. Therefore, the best choice for the disposition of the metal debris is the on-island landfill.

The concrete can be remediated under all three options. The best choice is the landfill on JI (option 3). Although the cost is slightly greater than option 1, the difference in the total scores is still 1.5 points and option 3 is the only practical option. The alternative would be to re-use the concrete as riprap or as reef-building material if it is needed. The differences in Long-Term Effectiveness and Reduction of Mobility make option 1 less attractive than option 3.

The only requirement that is not present in this evaluation is the need for a permit from the USACOE to allow the use of the concrete for shoreline enhancement (riprap) or reef building. The USACOE has indicated that riprap on JA is not advisable (Draft EA 2001). The USFWS refuge manager has stated that artificial reef building around JA has not been successful and he does not support further attempts at reef building in the shallow water around JA. “the Service [USFWS] is strongly opposed to artificial reefs at Johnston Atoll. The atoll comprises more than 50 square miles of shallow water coral reef platform. There is no need for an artificial reef in this extensive coral reef ecosystem” (e-mail, L. Hayes to G. Hall, 2001). USACOE would have to consider the USFWS opinion before granting the permit. Additionally, the USACOE would need to determine whether dumping of the concrete debris would be a violation of the Ocean Dumping Act and/or international treaties as it considered a request for either permit. In view of this, it is unlikely that a permit would be granted for either riprap or reef building at JA.

7.6.7 Conclusion

The best choice is a landfill on JI. This option protects human health and the environment, attains the cleanup objectives while reducing the threats from further releases, and is cost-efficient while taking into account the remoteness of JA. It is the best choice with respect to short-term effectiveness and is the only practical option in terms of implementability.

8 "ABOVE" PILE OPTION ANALYSIS

There are three choices for the “above” pile on JI for a total of eight options. The choices are either to create a landfill on JI, ship the pile off-island to a permitted radioactive facility in the continental U.S., or no action. The landfill would be in the existing LE-1 area excavation. Six landfill options are possible; each involve placing the “above” pile over the top of any metal and/or concrete debris, and covering it with a cap from the “below” pile. The variations are any additional coverings or treatments. The eight considered options are: 1) “below” pile material as a clean cap alone (Clean Cap); 2) a geotextile liner and a clean cap; 3) a concrete cap and a clean cap; 4) a 6-sided concrete vault with a clean cap (Concrete Vault); 5) a concrete slurry mix and a clean cap (Slurry Mix and Clean Cap); 6) vitrification of the “above” pile with a clean cap (Vitrifying the “Above” Pile); 7) No action; or 8) shipment to an off-island radioactive waste facility (Shipment Off-island).

The discussion of each “above” pile option that follows accepts option 3 for the metal and concrete to be the best choice. This is factored into the evaluation of each “above” pile option.

8.1 Option 1: Clean Cap

Containment of the entire “above” pile by constructing a landfill with the existing excavation hole in the LE-1 area. The metal and any concrete debris would be placed flat on the bottom of the landfill. The coral would be brought in lifts, wetted down, and then compacted to minimize void spaces and to speed the natural “cementing together” of the coral. A 61-cm (two-foot) (minimum) thick clean cap would be placed on the top using the coral from the “below” pile. This clean coral would also be brought in lifts, wetted down, and then compacted to minimize void spaces and to speed up the natural “cementing together” of the coral. The landfill side slopes would not be greater than 10:1. This slope will encourage drainage, preclude ponding on the landfill top, promote revegetation, and support bird nesting (construction-and-demolition type landfill, see Figure 13). *Figures 13-18 are for illustration purposes only and are not drawn to scale*. The DTRA will use the existing excavation and not excavate further.

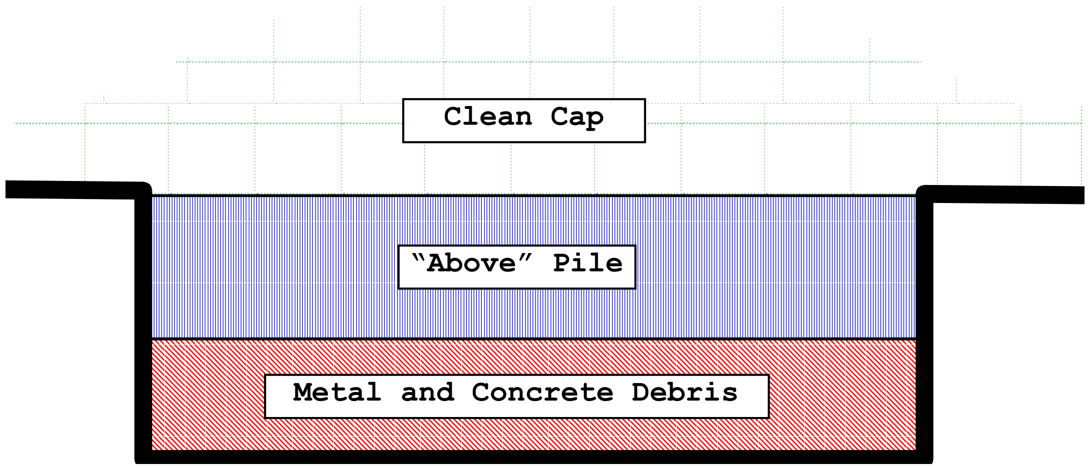


Figure 13 Clean Cap

8.2 Option 2: Geotextile Liner and Clean Cap

Containment of the entire "above" pile by constructing a landfill per option 1. A geotextile liner (a processed membrane material used to avoid water/humidity penetration) would be placed on top of the "above" material and below the 61-cm (two-foot) -thick clean cap (construction-and-demolition type landfill, see Figure 14.).

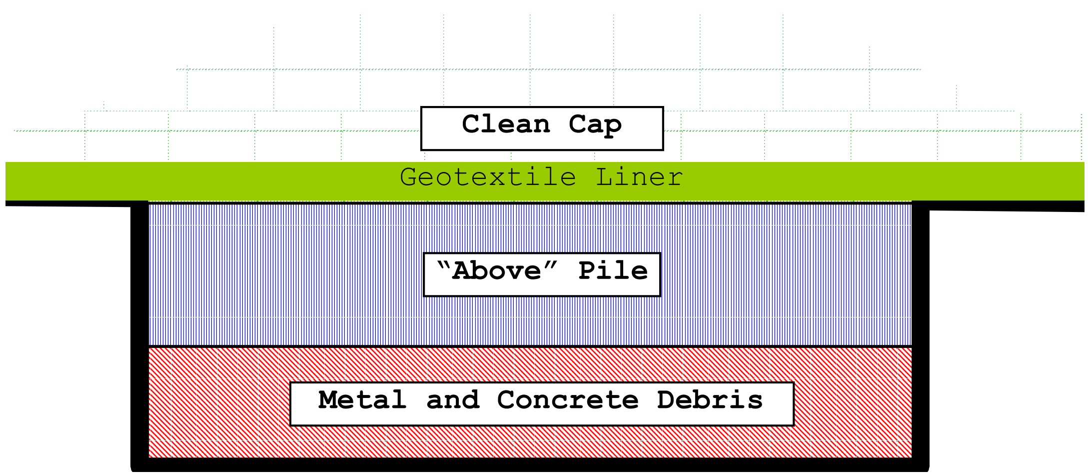


Figure 14 Geotextile Liner and Clean Cap

8.3 Option 3: Concrete Cap and Clean Cap

Containment of the entire "above" pile by constructing a landfill per option 1. An impermeable concrete cap (3,000 pounds per square inch (psi) concrete at 20 cm (8 in) thick) would separate the "above" pile from the 61-cm (two-foot) -thick clean layer on top. The impermeable concrete cap would prevent water infiltration into the “above” pile for the duration of its lifetime (100 years). A 61-cm (two-foot) thick clean cap would be placed on the top of the concrete using the coral from the “below” pile as previously stated. (construction-and-demolition type landfill, see Figure 15).

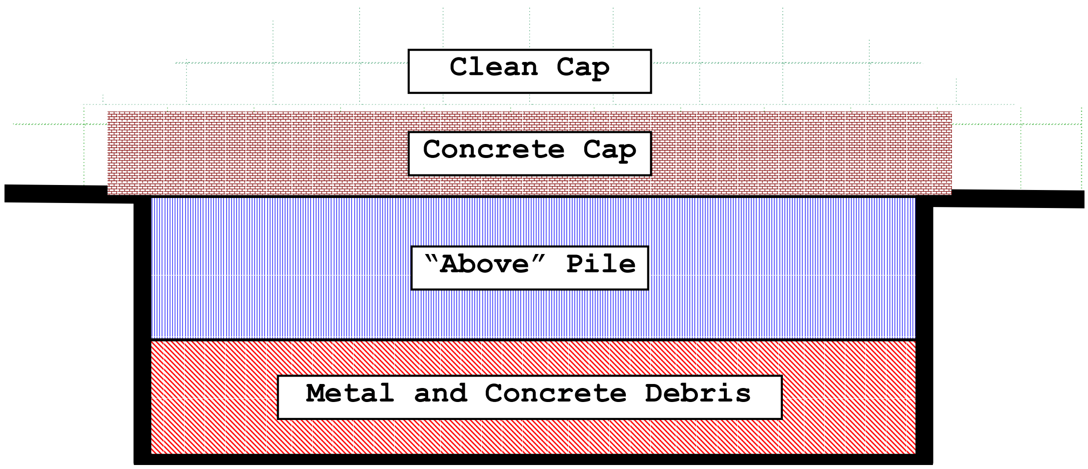


Figure 15 Concrete Cap with Clean Cap

8.4 Option 4: Concrete Vault

Containment of the entire contaminated pile by constructing a landfill in the existing excavation in the LE-1 area in a 6-sided concrete vault with the top covered with a clean cap. For the purposes of this analysis only, the following assumptions are made: the vault size is 104 m by 134 m with a top 2.5 to 3.5 m above the floor (341 feet by 439 feet with a top 8 to 12 feet above the floor), and with a wall, floor and ceiling thickness of 20 cm (8 in). The metal and any concrete debris would be placed flat on the bottom of the landfill. All of the coral would be brought in lifts, wetted down, and then compacted to ensure no void spaces and to speed up the natural “cementing together” of the coral. The concrete roof would be poured next. A 61-cm (two-foot) -thick (minimum) clean cap would be placed on the top of the concrete using the coral from the “below” pile. This clean coral would also be brought in lifts, wetted down, and then compacted to ensure no void spaces and to speed up the natural “cementing together” of the coral. The clean cap slopes would not be greater than 10:1. This slope will encourage drainage, preclude ponding on the landfill top, promote revegetation, and support bird nesting (construction-and-demolition type landfill, see Figure 16).

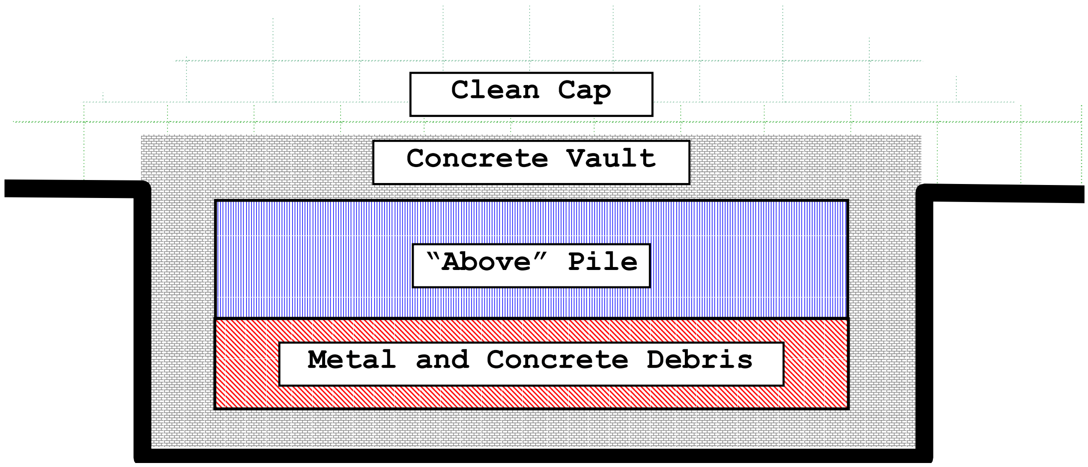


Figure 16 Concrete Vault with Clean Cap

8.5 Option 5: Slurry Mix and Clean Cap

Containment of the entire “above” pile by constructing a landfill per option 1. Before adding the “above” pile coral, a slurry mix combining imported cement and the “above” pile would be made. The concrete in the slurry would prevent water infiltration into the “above” pile for the duration of its lifetime. A 61-cm (two-foot) -thick clean cap from the “below” pile would be placed on top as previously described (construction-and-demolition type landfill, see Figure 17).

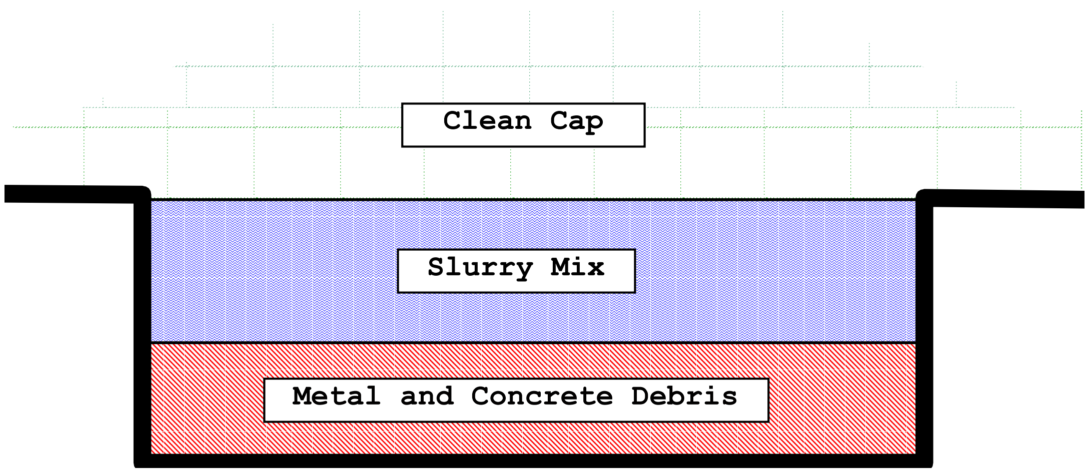


Figure 17 Concrete Slurry with Clean Cap

8.6 Option 6: Vitrifying the "Above" Pile

Containment of the entire “above” pile by constructing a landfill per option 1. Before adding the “above” pile, it would be processed into a vitrified mixture. (NOTE: vitrification is the process whereby material is encased inside a molten glass matrix. This is similar to an expected storage method for inside Yucca Mountain, Nevada.) The top of the vitrified material would be covered with a 61-cm (two-foot) -thick layer of coral from the “below” pile as previously described (construction-and-demolition type landfill, see Figure 18).

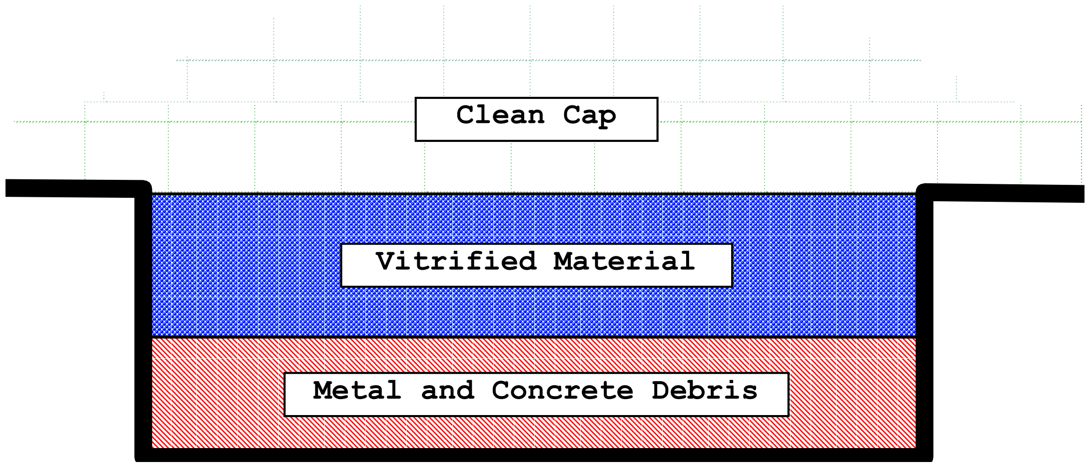


Figure 18 Vitrified Material with Clean Cap

8.7 Option 7: No Action

Leave the entire pile as it is and take no further action to process, stabilize, or move the pile (see Figure 9).

8.8 Option 8: Shipment Off-Island

Shipment of the entire “above” pile to an authorized radioactive waste disposal facility in the continental U.S. A complete radiological characterization survey would be required to define the activity being shipped. The level of the characterization survey is completely dependent upon the final destination, but is expected to include soil samples and a review of SGS computer processing records. Potential sites are the Envirocare facility and the NTS. The pile would be shipped from JI via Hawaii to a major port on the west coast of the continental U.S., then transported to the final disposal site.

8.9 Application of the Performance Criteria to the "Above" Pile Options

The following is a discussion of the application of the performance criteria. Table 5 below summarizes the results of applying the performance criteria to the “above” pile options.

8.9.1 Option 1: Clean Cap

Protect Human Health and the Environment

The placement of the “above” pile in the LE-1 area would remove the primary human exposure route, inhalation, by burying it. The clean cap of no less than two feet would also provide exceptional shielding for the ^{241}Am gamma ray (see Annex E for gamma attenuation calculations). The ground-burrowing birds on JA do not generally burrow below 2 vertical feet. Therefore, the 61-cm (two-foot) cap would prevent wildlife exposure to the “above” pile material. The cementitious nature of the JA coral would require heavy equipment to remove both the clean cap and the “above” pile once the compaction process is completed. The chemistry of plutonium oxide inhibits its solubility in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). This option meets this criterion.

Attain Cleanup Objectives

The placement of the “above” pile in the LE-1 area would eliminate the likelihood of human exposure and availability to the environment. This option meets the requirements of this criterion.

Remediate New Sources

The landfill would slow any potential release of the radioactive material by locking it inside the coral matrix. The chemical and physical properties of the plutonium oxide (melting point, insolubility in water, particle absorption tendencies (ORNL 2000a, ORNL 2000b, Wolf et al. 1995) combine to restrict the spread of contamination by locking the material into the landfill. This option meets this criterion.

8.9.2 Option 2: Geotextile Liner and Clean Cap

Protect Human Health and the Environment

The placement of the “above” pile in the LE-1 area would remove the primary human exposure route, inhalation, by burying it. The geotextile liner would greatly restrict any water intrusion in the “above” pile for the liner’s lifetime. The chemistry of plutonium oxide inhibits its solubility in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). The clean cap of no less than two feet would also provide exceptional shielding for the americium gamma ray (see Annex E for gamma attenuation calculations). The ground burrowing birds on JA do not generally burrow below two vertical feet. Therefore, the 61-cm (two-foot) cap would prevent wildlife from exposing the geotextile liner. Furthermore, the cementitious nature of the JA coral would require heavy equipment to remove both the clean cap and the “above” pile once the compaction process is completed. This option meets this criterion. However, if the seawall and landfill fail, the released geotextile liner may become a hazard to fish and wildlife.

Attain Cleanup Objectives

The placement of the “above” pile into the existing excavation in the LE-1 area would eliminate the primary human exposure route, inhalation, by burying it and prevent it from being available to humans and the environment. This option meets this criterion.

Remediate New Sources

The landfill would slow any potential release of the radioactive material by locking it inside the coral matrix, beneath the liner, and under the clean cap. The liner would also serve as an erosion indicator. The chemical and physical properties of the plutonium oxide (melting point, insolubility in water, particle absorption tendencies) (ORNL 2000a, ORNL 2000b, Wolf et al. 1995) combine to restrict the spread of contamination by locking the material into the landfill. This option meets this criterion.

8.9.3 Option 3: Concrete Cap and Clean Cap

Protect Human Health and the Environment

The placement of the “above” pile in the LE-1 area would remove the primary human exposure route, inhalation, by burying it. The eight-inch-thick concrete cap would ensure that no ground-burrowing birds would be able to enter the buried “above” pile. The concrete cap would provide intruder protection since it would require heavy equipment to remove it. The concrete cap and clean cap of no less than two feet would provide additional shielding for the americium gamma ray (see Annex E for gamma attenuation calculations). The chemistry of plutonium oxide inhibits its solubility in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). This option meets this criterion.

Attain Cleanup Objectives

The placement of the “above” pile in the LE-1 area, covered with the concrete cap, then covered with the clean cap would eliminate the primary human exposure route, inhalation, by burying it and prevent it from being available to humans and the environment. This option meets this criterion.

Remediate New Sources

The landfill would slow any potential release of the radioactive material by locking it inside the coral matrix, under the concrete cap, and under the clean cap. The concrete cap would also serve as an erosion indicator. The chemical and physical properties of the plutonium oxide (melting point, insolubility in water, particle absorption tendencies) (ORNL 2000a, ORNL 2000b, Wolf et al. 1995) combine to restrict the spread of contamination by locking the material into the landfill. The concrete cap would provide additional protection from severe weather for the duration of its lifetime (approximately 100 years). This option meets this criterion.

8.9.4 Option 4: Concrete Vault

Protect Human Health and the Environment

The placement of the “above” pile in the LE-1 area inside a Concrete Vault would remove the primary human exposure route, inhalation. The concrete would completely shield the radiation. The eight-inch-thick concrete walls, floor and ceiling would ensure that no ground-burrowing birds would be able to enter the buried “above” pile. The concrete vault would provide intruder protection since it would require heavy equipment to remove it. The concrete vault would also provide severe weather protection. The cementitious nature of the clean coral cap would also require heavy equipment to remove the “above” pile once the compaction process is completed. The chemistry of plutonium oxide inhibits its solubility in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). This option meets this criterion.

Attain Cleanup Objectives

The placement of the “above” pile in the LE-1 area and entombment in a concrete vault, and covered with the clean cap would eliminate the primary human exposure route, inhalation, by burying it and preventing it from being available to humans or the environment for the duration of its lifetime. This option meets this criterion.

Remediate New Sources

The landfill would slow any potential release of the radioactive material by locking it inside the coral matrix, inside the concrete vault, and under the clean cap. The concrete vault would slow any potential release of the plutonium oxide for the lifetime of the vault (approximately 100 years). The chemical and physical properties of the plutonium oxide (melting point, insolubility in water, particle absorption tendencies) (ORNL 2000a, ORNL 2000b, Wolf et al. 1995) combine to restrict the spread of contamination by locking the material into the landfill. The concrete vault would provide additional protection from severe weather. This option meets this criterion.

8.9.5 Option 5: Slurry Mix and Clean Cap

Protect Human Health and the Environment

The placement of the “above” pile mixed with cement to form a concrete block in the LE-1 area would remove the primary human exposure route, inhalation, by burying it. The resulting concrete block would ensure that no ground-burrowing birds would be able to enter the buried “above” pile. The concrete block would provide intruder protection since it would require heavy equipment to remove it. Removal of the clean cap would also require heavy equipment. The chemistry of plutonium oxide inhibits its solubility in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). This option meets this criterion.

Attain Cleanup Objectives

The placement of the “above” pile mixed with cement to form a concrete block in the LE-1 area then covered with the clean cap would eliminate the primary human exposure route, inhalation, by burying it and preventing it from being available to humans and the environment. This option meets this criterion.

Remediate New Sources

The landfill would slow any potential release of the radioactive material by locking it inside the concrete matrix under the clean cap. The solidified slurry would slow any potential release of the plutonium oxide for its lifetime. The chemical and physical properties of the plutonium oxide (melting point, insolubility in water, particle absorption tendencies) (ORNL 2000a, ORNL 2000b, Wolf et al. 1995) combine to restrict the spread of contamination by locking the material into the landfill. The concrete block would provide additional protection from severe weather. This option meets this criterion.

8.9.6 Option 6: Vitrifying the "Above" Pile

Protect Human Health and the Environment

Placing the vitrified “above” pile in the LE-1 area would remove the primary human exposure route, inhalation, by encapsulating it in glass and then burying it. The vitrified mass would ensure that no ground burrowing birds would enter the “above” pile. The vitrified block would provide intruder protection since it would require heavy equipment to remove, as would the clean coral cap. The vitrification process eliminates any movement, in or out, by water. The chemistry of plutonium oxide inhibits its solubility in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). This option meets the requirements of this criterion.

Attain Cleanup Objectives

Placing the vitrified “above” pile in the LE-1 area plus a clean cap would eliminate the primary human exposure route, inhalation, by burying it and preventing it from being available to humans and the environment. This option meets this criterion.

Remediate New Sources

The vitrified block would require physical destruction of the matrix to release the radioactive material. If the matrix were to fail, the chemical and physical properties of the plutonium oxide (melting point, insolubility in water, particle absorption tendencies (ORNL 2000a, ORNL 2000b, Wolf et al. 1995) combine to restrict the spread of contamination by locking the material into the landfill. The vitrified block would provide additional protection from severe weather. This option meets this criterion.

8.9.7 Option 7: No Action

Protect Human Health and the Environment

The “above” pile presents limited radiological risk as it stands, but it is subject to weathering and erosion. See the air concentration data in Figure 1. Historically the air concentrations of plutonium on JI are below the allowable general public limits (10 CFR Part 20). This option meets this criterion.

Attain Cleanup Objectives

This option does not eliminate, reduce, or control the present release rate of material from the “above” pile. This option does not meet this criterion.

Remediate New Sources

Additional radioactive material may become available to the environment as the “above” pile erodes. This must be tempered with the fact that air sampling directly downwind of the “above” pile has not found air concentrations above allowable limits (Figure 1). Therefore, the amount of material added to the air is expected to be negligible, but could be considered a new source. This option does not meet this criterion.

8.9.8 Option 8: Shipment Off-Island

Protect Human Health and the Environment

The movement of the radioactive material would, by virtue of the transportation requirements, prevent human exposure at JA. A complete radiological characterization survey would be required to define the activity being shipped. By shipment to a radioactive waste facility, the radioactive material would be isolated and human health and the JA environment would be protected. This would, however, simply transfer the potential risk of exposure to the facility or to any intermediate point along the shipment route. This option meets the requirements of this criterion.

Attain Cleanup Objectives

Removing the “above” pile to a waste facility will achieve the cleanup objectives by eliminating both the exposure pathway and the source term. This option meets this criterion.

Remediate New Sources

This option would remove the radioactive material from JA as a potential new source for release. This option meets this criterion.

Table 5 “Above" Pile Performance Criteria Summary				
	Performance Criteria			
Option	Protect Human Health and the Environment	Attain Cleanup Objectives	Remediate New Sources	Survive
1: Clean Cap	Yes	Yes	Yes	Yes
2: Geotextile Liner and Clean Cap	Yes*	Yes	Yes	Yes
3: Concrete Cap and Clean Cap	Yes	Yes	Yes	Yes
4: Concrete Vault	Yes	Yes	Yes	Yes
5: Slurry Mix and Clean Cap	Yes	Yes	Yes	Yes
6: Vitrifying the “Above” Pile	Yes	Yes	Yes	Yes
7: No Action	Yes	No	No	No
8: Shipment Off-Island	Yes	Yes	Yes	Yes

* However, if the seawall/landfill fails, the geotextile fabric may become a hazard to the fish and wildlife.

8.10 Application of the Evaluation Criteria on the Surviving "Above" Pile Options

8.10.1 Option 1: Clean Cap

Long-Term Effectiveness: 3

The isolation of the radioactive material inside a landfill on JA would remove the radioactive material's availability to humans and the environment albeit leaving the material physically on JI locked in the coral matrix. As long as the cap material is in place, there is no method (short of human re-intervention, catastrophic seismic or volcanic event, or sea-level rise) for the material to move. The chemistry of PuO_2 indicates that it is insoluble in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). The RCA seawall portion is the least affected of the entire JI seawall since the waves run parallel to the RCA seawall and therefore there is no intense wave action. These facts result in a rating of highly certain to be reliable for 100-1,000 years and an assigned value of 3.

Reduction of Toxicity, Mobility or Volume: 3, 3

The isolation of the “above” pile in a JI landfill would greatly restrict the mobility of the radioactive material by locking it inside the coral matrix. The option is evaluated as a significant reduction of the toxicity, mobility, or volume and assigned a value of 3 for both humans and the environment on JI.

Short-Term Effectiveness: 2

The handling and placement of the “above” pile may re-suspend radioactive material because of the landfill construction process. This risk can be controlled with the application of respiratory protection for the construction workers. The other physical risks are those commensurate with operations of this type (use of heavy equipment, cutting tools, and jackhammers, etc.). This option is effective, but it introduces new minimal risks and is assigned a value of 2.

Implementability: See below

Time: The estimated time to move the metal and concrete debris, the “above” pile, and create the cap is 50 weeks.

Cost: The estimated cost for this option is $1,840,000. This cost would include the placement of the concrete and metal debris in the bottom of the landfill. See Annex F for a specific cost analysis.

Practicality: Movement of the “above” pile and the clean cap could be done with the existing heavy equipment on-island and is practical for JA.

8.10.2 Option 2: Geotextile Liner and Clean Cap

Long-Term Effectiveness: 3

The isolation of the radioactive material inside a landfill on JA would remove the radioactive material from availability to humans and the environment albeit leaving the material physically on JI locked in the coral matrix and under the liner. The expected lifetime of the liner is 100-1,000 years. As long as the physical integrity of the liner is intact, it should continue to provide protection for its lifetime. As long as the clean cap material is in place, there is no method (short of human re-intervention or catastrophic natural event such as a volcanic eruption, earthquake, tsunami, or sea-level rise) for the radioactive material to move. The chemistry of plutonium oxide indicates that it is insoluble in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). The RCA seawall portion is the least affected of the entire JI seawall since the waves run parallel to the RCA seawall and, therefore, there is no intense wave action. These facts lead to an evaluation of highly certain to be reliable for 100-1,000 years and assigned a value of 3. The geotextile liner has the potential to become a hazard to fish and wildlife in the event the seawall/landfill fails and the fabric enters the environment.

Reduction of Toxicity, Mobility or Volume: 3, 3

The isolation of the “above” pile in a JI landfill would greatly restrict the mobility of the radioactive material by locking it inside the coral matrix and under the liner. It would not reduce the toxicity or the volume. The option is evaluated as a significant reduction of the toxicity, mobility, or volume and assigned a value of 3 for both humans and the environment on JI.

Short-Term Effectiveness: 2

The physical placement of the "above" pile, placement of the liner, and the clean cap may re-suspend radioactive material because of the landfill construction process. This risk can be controlled with the application of respiratory protection for the construction workers. The other physical risks are those commensurate with operations of this type (use of heavy equipment, cutting tools, and jackhammers, etc.) This option is effective but it introduces new minimal risks and is assigned a value of 2.

Implementability: See below

Time: The estimated time to move the metal debris, concrete debris, "above" pile, install the liner, and place the cap is 52 weeks.

Cost: The estimated cost for this option is $1,900,000. This cost would include moving the concrete and metal debris. See Annex F for a specific cost analysis.

Practicality: Placement of the "above" pile, geotextile liner and the clean cap could be done with the heavy equipment on-island and is practical for JA.

8.10.3 Option 3: Concrete Cap and Clean Cap

Long-Term Effectiveness: 3

Isolation of the radioactive material inside a landfill on JI would remove the radioactive material from availability to humans and the environment albeit leaving the material physically on JA locked in the coral matrix, covered with a concrete cap which is then covered with a clean coral cap. The expected lifetime of the concrete cap is a maximum of 100 years. As long as the physical integrity of the cap remains intact, it should continue to provide physical intruder protection for its lifetime. As long as the clean cap material is in place, there is no method (short of human re-intervention, a catastrophic natural event such as a volcanic eruption, earthquake, tsunami, or sea-level rise) for the radioactive material to move. The chemistry of plutonium oxide indicates it is insoluble in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). The seawall closest to the RCA is not subject to intense wave action since the waves run parallel to the RCA seawall. This makes it the least affected of the entire seawall. These facts lead to an evaluation of highly certain to be reliable for 100-1,000 years and assigned a value of 3.

Reduction of Toxicity, Mobility or Volume: 3, 3

Isolation of the "above" pile in a JI landfill with a concrete cap then covered with a clean cap would greatly restrict the mobility of the radioactive material. The option is evaluated as a significant reduction of the toxicity, mobility, or volume and assigned a value of 3 for both humans and the environment on JI.

Short-Term Effectiveness: 2

Placement of the “above” pile, pouring of the concrete cap, and the clean cap may re-suspend radioactive material because of the construction process. This risk can be controlled with the application of respiratory protection. The other physical risks are those commensurate with operations of this type (heavy equipment use, cutting, jackhammers etc.) This option is effective, but it introduces new minimal risks and is assigned a value of 2.

Implementability: See below

Time: The estimated time to move the metal and concrete debris, the “above” pile, pour the concrete cap, and place the clean cap is 58 weeks.

Cost: The estimated cost for this option is $2,340,000. This cost would include moving the concrete and metal debris. See Annex F for a specific cost analysis.

Practicality: Movement of the “above” pile and the clean cap could be done with the heavy equipment on-island and is practical for JA. The pouring of the concrete cap however, would require obtaining additional equipment (concrete paver, cement trucks, and a batch plant) from off-island and follow-on disposition. Therefore, this option is not practical.

8.10.4 Option 4: Concrete Vault

Long-Term Effectiveness: 3

Isolation of the radioactive material inside a landfill vault on JI would remove the radioactive material from availability to humans and the environment albeit leaving the material physically on JI locked in the coral matrix inside the concrete vault. The expected lifetime of the concrete vault is 100 years. As long as the physical integrity of the vault is intact, it should continue to provide physical intruder protection. As long as the clean cap material is in place, there is no method (short of human re-intervention or catastrophic natural event such as a volcanic eruption, earthquake, tsunami, or sea-level rise) for the radioactive material to move. The chemistry of plutonium oxide indicates that it is insoluble in the JA environment (ORNL 2000a, ONRL 2000b, Wolf et al. 1995). The seawall closest to the RCA is not subject to intense wave action since the waves run parallel to the RCA seawall. This makes it the least affected of the entire seawall. These facts lead to an evaluation of highly certain to be reliable for 100-1,000 years and assigned a value of 3.

Reduction of Toxicity, Mobility or Volume: 3, 3

Isolation of the "above" pile in a JI landfill inside a concrete vault followed by a clean cap would greatly restrict the mobility of the radioactive material. The option is evaluated as significant reduction of the toxicity, mobility, or volume and assigned a value of 3 for both humans and the environment on JI.

Short-Term Effectiveness: 2

Placement of the “above” pile, construction of the concrete vault, and installation of the clean cap may re-suspend radioactive material because of the construction process. This risk can be controlled with the application of respiratory protection for the construction workers. The other physical risks are those commensurate with operations of this type (use of heavy equipment, cutting tools, etc.). This option is effective, but it introduces new minimal risks and is assigned a value of 2.

Implementability: See below

Time: The estimated time to move the metal and concrete debris, the “above” pile, construct the concrete vault, and place the clean cap is 78 weeks.

Cost: The estimated cost for this option is $3,150,000. This cost would include the cost of placing the concrete and metal debris in the bottom of the landfill. See Annex F for a specific cost analysis.

Practicality: Movement of the “above” pile and the clean cap could be done with the heavy equipment on-island and is practical for JA. Pouring of the vault would require obtaining additional equipment (concrete paver, cement trucks, and a batch plant) from off-island and the follow-on equipment disposition. Therefore, this option is not practical.

8.10.5 Option 5: Slurry Mix and Clean Cap

Long-Term Effectiveness: 3

Isolation of the radioactive material inside a landfill on JA would remove the radioactive material from availability to humans and the environment albeit leaving the material physically on JI locked in the concrete matrix under a clean coral cap. The expected lifetime of the concrete slurry is 100 years. As long as the physical integrity of the slurry is intact, it should continue to provide physical intruder protection for its lifetime. As long as the clean cap material is in place, there is no method (short of human re-intervention or a catastrophic natural event such as a volcanic eruption, earthquake, tsunami, or sea-level rise) for the radioactive material to move. The chemistry of plutonium oxide indicates it is insoluble in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995). The seawall closest to the RCA is not subject to intense wave action since the waves run parallel to the RCA seawall. This makes it the least affected portion of the entire seawall. These facts lead to an evaluation of highly certain to be reliable for 100-1,000 years and is assigned a value of 3.

Reduction of Toxicity, Mobility or Volume: 3, 2

Isolation of the "above" pile in a JI landfill with a concrete slurry covered with a clean cap would greatly restrict the mobility of the radioactive material by locking it inside a concrete matrix. However, this does have consequence of increasing the total volume of contaminated material. The option is evaluated as a significant reduction of the toxicity and mobility, but an increase in the volume and is assigned a value of 3 for humans and 2 for the environment on JI.

Short-Term Effectiveness: 2

The placement of the "above" pile, pouring of the concrete slurry, and the clean cap may re-suspend radioactive material because of the landfill construction process. This risk can be controlled with the application of respiratory protection for the construction workers. The other physical risks are those commensurate with operations of this type (use of heavy equipment, cutting tools, and jackhammers, etc.). This option is effective, but it introduces new minimal risks and is assigned a value of 2.

Implementability: See below

Time: The estimated time to move the metal debris, concrete debris, “above” pile, pour the concrete slurry, and place the clean cap is 64 weeks.

Cost: The estimated cost for this option is $3,486,000 using a 4% cement mixture. This cost would include the cost of placement of the concrete and metal debris piles in the bottom of the landfill. See Annex F for a specific cost analysis.

Practicality: Movement of the “above” pile and the clean cap could be done with the heavy equipment on-island and is practical for JA. Pouring of the slurry would require obtaining additional equipment (concrete paver, cement trucks, and a batch plant or a harrow) from off-island and follow-up disposal of the concrete equipment since the slurry would be slightly contaminated. Therefore, this option is not practical.

8.10.6 Option 6: Vitrifying the “above” Pile

Long-Term Effectiveness: 4

Isolation of the radioactive material inside a landfill on JI would remove the radioactive material from availability to humans and the environment albeit leaving the material physically on JI locked in the vitrified coral/glass matrix. The expected lifetime of the vitrified coral/glass matrix is greater than 1,000 years. As long as the clean cap material is in place, there is no method (short of human re-intervention or catastrophic seismic or volcanic events or a sea-level rise) for the radioactive material to move. The chemistry of plutonium oxide indicates it is insoluble in the JA environment (ORNL 2000a, ORNL 2000b, Wolf et al. 1995).

The seawall closest to the RCA is not subject to intense wave action since the waves run parallel to the RCA seawall. This makes it the least affected portion of the entire seawall. These facts lead to an evaluation of highly certain to be reliable for greater than 1,000 years and is assigned a value of 4.

Reduction of Toxicity, Mobility, or Volume: 4, 3

Encapsulation of the "above" pile inside a vitrified coral/glass matrix then covered with a clean cap would eliminate the mobility of the radioactive material. However, this does have consequence of increasing the total volume of contaminated material. The option is evaluated as elimination of the toxicity, mobility, or volume and assigned a value of 4 for humans and a value of 3 for the environment on JI.

Short-Term Effectiveness: 1

Vitrification of the “above” pile and placement of the clean cap may re-suspend radioactive material because of the construction process. This risk can be controlled with the application of respiratory protection for the construction workers. The other physical risks are those commensurate with vitrification operations (high voltage, high temperature) and use of heavy equipment. This option is effective, but introduces significant new risks and is assigned a value of 1

Implementability: See below

Time: The estimated time to move the metal and concrete debris, vitrify the “above” pile, and place the clean cap is 331 weeks with one 25 ton-per-day vitrification plant.

Cost: The estimated cost range for this option is $20,750,000-24,575,000. See Annex F for a specific cost analysis.

Practicality: The movement of the “above” pile and the clean cap could be done with the heavy equipment on-island and is practical for JA. The vitrification of the “above” pile requires a large amount of industrial equipment to be moved on-island (vitrification plant and support equipment). The coral sand at JI essentially contains no silica to make glass. About 45% silica by volume (approximately 21,000 cubic yards) will have to be shipped to JI and added to the “above” pile (Bartone 2000). The vitrification plant requires power from either the electrical grid or by burning fuel (propane) to melt the matrix. Vitrification of the “above” pile is not practical for JA.

8.10.7 Option 8: Shipment Off-Island

Long-Term Effectiveness: 4

Removal of the “above” pile to a permitted radioactive waste facility would isolate the material from human exposure and eliminate the spread of contamination on JA. This option is evaluated as being highly certain for greater than 1,000 years and is assigned a value of 4 since the material would be removed from JI. This, however, simply transfers the potential for any exposures to the facility in the continental U.S. or any intermediate point on the transport route.

Reduction of Toxicity, Mobility or Volume: 4, 4

Removal of the "above" pile to a commercial facility would eliminate the mobility of the radioactive material. The option is evaluated as eliminating the toxicity, mobility, or volume with an assigned value of 4 for both humans and the environment on JI.

Short-Term Effectiveness: 1

The preparation for shipment of the "above" pile may re-suspend radioactive material because of the shipment preparation process. This risk can be controlled with the application of respiratory protection for the workers. The other physical risks are those commensurate with operations of this type (heavy equipment use). The transportation risks can be quantified using the Sandia National Laboratory Transportation System Analysis Department's value of accident probability per shipment per mile of 2.5 $x10^{-6}$ (Masey, personal communication 1999). The number of shipments is calculated using two 20-foot dry cargo containers. Table 6 below shows the estimated probability of a highway accident for each potential disposal site. This option is effective, but introduces significant new risks and is assigned a value of 1.

Table 6 Estimated Number of Highway Accidents for "Above" Pile Shipments

			Number of Projected Accidents	
Item	Volume (m^3)	Number of Truck Shipments	NTS	Envirocare
“Above” Pile	45,000	1608	1.43E+00	3.06E+00

Implementability: See below

Time: The time required to characterize, transport, and dispose of the “above” pile is 50 weeks.

Cost: The estimated cost for this option is $49,942,000. This cost does not include the movement of the concrete and metal debris piles. See Annex F for a specific cost analysis.

Practicality: Preparing and shipping the “above” pile would require additional equipment and materials, which is marginally practical for JA; however, the accident risk is not acceptable for the DTRA. This would require massive shipments to and from JI to complete. Therefore, this option is not practical.

8.10.8 Evaluation Criteria Summary for the “Above” Pile

Table 7 "Above" Pile Evaluation Summary

Option	Long-Term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability		
				Time	Cost ($)	Practical for JI
1: Clean Cap	Highly certain for 100-1,000 years **(3)**	Significant reduction of mobility for humans and the JA environment (**3**)	Yes, but introduces new risks (**2**)	50 weeks	1,840,000	Yes
2: Geotextile Liner and Clean Cap	Highly certain for 100-1,000 years **(3)**	Significant reduction of mobility for humans and the JA environment (**3**)	Yes, but introduces new risks (**2**)	52 weeks	1,900,000	Yes
3: Concrete Cap and Clean Cap	Highly certain for 100-1,000 years **(3)**	Significant reduction of mobility for humans and the JA environment (**3**)	Yes, but introduces new risks (**2**)	58 weeks	2,340,000	No
4: Concrete Vault	Highly certain for 100-1,000 years **(3)**	Significant reduction of mobility for humans and the JA environment (**3**)	Yes, but introduces new risks (**2**)	78 weeks	3,150,000	No
5: Slurry Mix and Clean Cap	Highly certain for 100-1,000 years **(3)**	1) Significant reduction of mobility for humans (**3**) 2) However an increase in volume for the environment (**2**)	Yes, but introduces new risks (**2**)	64 weeks	3,486,000	No
6: Vitrifying the “above” Pile	Highly certain greater than 1,000 years **(4)**	1) Elimination of mobility for humans (**4**) 2) However an increase in volume for the environment (**3**)	Yes, but introduces new significant risks (**1**)	331 weeks (includes acquiring plant)	20,750,000-24,575,000	No
8: Shipment Off-Island	Highly certain greater than 1,000 years **(4)**	Elimination of mobility for humans and the JA environment (**4**)	Yes, but introduces new significant risks (**1**)	50 weeks	49,942,000	No

8.10.9 Analysis of the Evaluation Criteria

A ranking system was used to evaluate these criteria. The best score for each criterion was assigned a rank of 1. The worst was assigned a rank of 7. If more than one option had the same evaluation, the ranks were averaged and the average assigned to each option. All of the criteria are weighted the same. The rankings were then totaled to determine the best option (the one having the lowest total score).

Table 8 "Above" Pile Option Analysis and Ranking							
Option	Long-Term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability			Total Score
				Time	Cost	Practical for JA	
1: Clean Cap	5	4.5	3	1.5	1	1.5	***16.5***
2: Geotextile Liner and Clean Cap	5	4.5	3	3	2	1.5	***19***
3: Concrete Cap and Clean Cap	5	4.5	3	4	3	5	***24.5***
4: Concrete Vault	5	4.5	3	6	4	5	***27.5***
5: Slurry Mix and Clean Cap	5	7	3	5	5	5	***30***
6: Vitrifying the "above" Pile	1.5	2	6.5	7	6	5	***28***
8: Shipment Off-Island	1.5	1	6.5	1.5	7	5	***22.5***

8.10.10 Evaluation Criteria Summary

The best choice is option 1, Clean Cap, after applying the evaluation criteria. The difference in the total score between option 1 and the second choice (option 2) is 2.5 points. Option 1 protects human health and the environment, attains the clean-up objectives, remediates potential new sources and is the best choice in terms of cost and time while being practical for JA. The Long-Term Effectiveness criterion reveals that Options 1-5 are all equal from the perspective of the half-life of ^{239}Pu (24,141 years (Shlein 1992). Option 6 and 8 provide the most protection in the long term, but are much more expensive than the other options. The demonstrated radiological risk of the material on JA does not warrant vitrification since the plutonium oxide is not soluble at JA. An evaluation of the short-term effectiveness for Option 8 estimates between 1 to 3 highway accidents, and the DTRA believes that this is an excessive and unacceptable risk. Option 6 and 8 are impractical from the logistical point of view.

8.10.11 Conclusion

The best choice and preferred option is to create an on-island landfill following option 1. Option 2 was considered to provide an additional level of protection; however, the geotextile liner has the potential to become a hazard to fish and wildlife in the event the seawall/landfill fails and the fabric enters the environment. Option 2 will take longer to complete than option 1. The cost-effective option that protects the environment commensurate with the radiological risk is the capped construction-and-demolition type landfill with a 61 cm (2 foot)-thick minimum cap of clean coral (Option 1).

9 SEAWALL CONCERNS

Annex A calculates the estimated deposited activity in the ocean to be 87% of the material or 3.16×10^{13} Bq (853 curies (Ci)), the estimated deposited activity on JI is 13% or 4.74×10^{12} Bq (128 Ci), and the estimated activity in the “above” pile is 3.66×10^{11} Bq (9.9 Ci). The percentage of material in the “above” pile compared to material in the ocean is about 1%. Radioactive material was removed from JA and remediated in several ways: ocean disposal of debris after the missile aborts (DTRA 2000a), pushing of material into the lagoon, shipment of material to the NTS in the 1980s for disposal, and separation using the SGS. The effectiveness of the plutonium oxide remediation process is shown in the RCA radiological survey and the JI survey (DTRA 2000a, Weston 2001).

9.1 Seawall Failure

The seawall will fail without periodic maintenance and repair. A rough estimate of seawall duration is between 30-50 years (Richmond 2000). The last repair to a section of the seawall (not in the RCA) cost approximately $1,000,000 per 100 linear feet. The cost of replacing the entire seawall is approximately $316,800,000 (6-mile circumference). The seawall that is closest to the RCA is not subject to intense wave action since the waves run parallel to the RCA; therefore, the RCA seawall is perhaps the least affected section on JI.

9.2 Projected Erosion Rates

After the seawall fails, the ocean would likely reclaim the non-original portion of JA over 10-100 years (Richmond 2000). This forecast does not take into account hurricanes, rising sea levels, tsunamis, or earthquakes and assumes a single, catastrophic failure of the entire seawall. This estimate is very conservative, since in reality, only sections of the seawall will fail at any given time. The breach would then expand along the wall from that point as opposed to the entire perimeter failing at the same time. There is no way to know exactly what section of the seawall will fail first or what the ultimate sequence of events will be. An erosion rate range can be calculated by taking the time estimate of 10-100 years and dividing it by the non-original island footprint (625 acres, current footprint; 60 acres, original footprint) to calculate an estimated erosion rate. The projected erosion rate range is 565 acres/10 years to 565 acres/100 years or 56.5 acres/year to 5.65 acres/year. However, the erosion pattern on North and East Islands indicates erosion of dredged material on the east side and deposition on the west side. If this pattern holds for JI, then the landfill site would be at less risk due to its location.

9.3 Estimated Radioactive Material Flux

The estimated landfill size is 6 acres. The estimated time to release the contents ranges from 6 weeks to 1 year, once the erosion reaches the landfill site from wherever on the island the erosion begins.

The potential impact of this flux to the environment needs to be put into perspective with the present material existing in the ocean. The amount of additional material would be 11 Ci compared to an estimated 853 Ci currently in the ocean. This is 1% of the material presently in the ocean that would be released over time.

An additional calculation estimates the amount of total plutonium oxide that could be released into the lagoon if the entire island was to move into the lagoon. That activity total is determined by taking the average surface concentration (2.37 pCi/g) and the 625 acres of island

$$A_T = C\rho A$$

where

A_T = total activity
C = concentration
ρ = average density of the soil
A = area

The subsurface activity is calculated by taking the average subsurface concentration (2.57 pCi/g) and the post accident subsurface volume (300 acres at 8 feet) as shown in the equation below.

$$A_T = C\rho V$$

where

A_T = total activity
C = concentration
ρ = average density of the soil
V = volume

The result of these two calculations is an additional 0.07 Ci surface and 8.37 Ci subsurface added to the ocean. This is approximately a 1% increase of total activity. The resulting change in the target populations' doses and concentrations are shown below in Table 9.

Table 9 Current and Future Dose and Concentration Estimates

Target Population	Current Values	"Above" Pile into the Lagoon	Entire Atoll into the Lagoon
Fish Muscle Concentration (pCi/g wet muscle tissue)	1.11E-02	1.12E-02	1.13E-02
Fish Dose (cGy/yr)	1.87E-02	1.89E-02	1.91E-02
Human Dose (CEDE Sv/yr)			
Muscle Tissue	3.49E-04	3.53E-04	3.57E-04
Entire Fish	1.95E-03	1.98E-03	1.99E-03
Monk Seal (CEDE Sv/yr)	3.10E-02	3.13E-02	3.17E-02
Green Sea Turtle (cGy)	9.53E-04	9.64E-04	9.74E-04

9.4 Conclusion

Accounting for the uncertainties in the calculations there is no difference between the current values and the future values listed in Table 9. Therefore, the dose to each group is as low as reasonably achievable. Thus, seawall maintenance is unjustified considering the amount of plutonium oxide presently in the ocean.

10 LONG-TERM MONITORING REQUIREMENTS

After site remediation, the DTRA will monitor the remediation site for construction faults for five years or until routine, scheduled, normal airline service to JA is terminated, whichever is first. The 5-year monitoring period will allow time for any construction failures to occur and allow sufficient time for subsequent repairs before the island infrastructure is unable to support the logistics efforts to repair problems. An annual report will be prepared and provided to the island custodian. The DTRA will place a cap depth marker to allow measurement of any clean cap erosion. Permanent markers will be placed at the corners of the landfill, and the precise location of the landfill will be provided to the USFWS (the projected custodians of the island or to the appropriate island custodian). A deed restriction (or similar document) on digging inside the area bounded by the permanent markers will also help protect against human intrusion. If any contamination is found after landfill monitoring is completed, the contamination will be evaluated by the DTRA health physics staff. No other monitoring or land use restrictions are necessary for JA.

11 GROUNDWATER SURVEY

ORNL conducted two different studies to determine the actual groundwater plutonium concentration under the RCA. ORNL also conducted column tests to determine if under simulated groundwater movement, plutonium would move into solution. The results showed that the *in-situ* groundwater concentrations (at the area of maximum potential contamination) were 1% of the Federal Drinking Water Standard for alpha-emitting radionuclides. The column study found no statistical difference between the incoming groundwater and the leachate coming out. Plutonium oxide at JA does not significantly go into solution at JA. These results validate the landfill option. See Annex G for an expanded discussion of the ORNL groundwater survey.

12 SEDIMENT SAMPLING IN THE JA LAGOON

The DTRA contracted with the USACOE for the collection of sediment cores in the JA lagoon. Plutonium oxide concentrations both in surface and sub-surface sediments of the JA lagoon were characterized, and comparison data were established for biological sampling. There were a total of 197 laboratory samples prepared and analyzed from 113 sediment cores (109 usable) taken from the atoll. Five out of 197 laboratory samples had plutonium concentrations above the soil cleanup level of 13.5 pCi/g, but only one was less than 7.6 cm from the surface (0-3 in depth) with its activity at 14.9 pCi/g. The results show that the highest concentrations are at sediment depths between 15 – 30 cm (6-12 in). All elevated readings were collected from the area offshore of the RCA, as expected.

The lagoon survey results show that the existing plutonium or plutonium oxide in the lagoon is concentrated in rare spots and is largely no longer at the surface. The present hazard to lagoon biota is therefore minimal. See Annex H for an expanded discussion of the lagoon survey.

13 BIOTA SAMPLING AND ANALYSIS

Dr. Philip S. Lobel (Boston University) and Lisa Kerr Lobel (University of Massachusetts, Boston) collected fish and prepared them for analysis. Ninety-two fish samples and 20 alga samples were collected from 6 different sites. ORNL conducted subsequent laboratory analysis. Fish bodies, fish viscera, and alga samples were analyzed by alpha spectrometry for ^{241}Am, ^{244}Cm, ^{238}Pu, $^{239/240}$Pu, and ^{242}Pu. The data collected from this biota survey were used to determine the estimated radiation dose to fish, to humans consuming the fish, to green sea turtles consuming the algae, and to Hawaiian monk seals consuming the fish. A more complete discussion is in Annex I.

The dose analysis concluded there was no significant dose to humans or any species from the radionuclides present on or around JA. Several conservative assumptions were made, resulting in a worst-case radiation-exposure scenario. In most cases, these are unrealistic assumptions but they represent the maximum dose to humans or the species of interest. Table 9, section 9.3, above summarizes the results of the current dose calculations and concentrations.

The JI risk assessment calculated the dose to selected birds representing the atoll's bird population (seabirds and migratory shorebirds). The dose calculations accounted for both external and internal exposures. JA birds do not have a significant radiological risk due to their feeding habits, their lifestyles, and the nature of JA contamination. The risk assessment concluded that "the estimated doses are a small fraction of the IAEA and DOE recommended limit" with the highest dose being less than 8.1×10^{-4} cGy/year (based on 13.5 pCi/g TRU soil concentration) (DTRA 2000a, p. C-51). The risk assessment also estimated the residual total TRU soil concentration that would result in individual doses at their respective limits and concluded, "it would appear extremely unlikely that either the shorebirds or seabirds resident (or migratory) at JA would receive doses in excess of the recommended limits" (DTRA 2000a, p. C-51).

14 SUMMARY

The preferred option is a landfill for the metal debris, concrete debris, and the "above" pile inside the RCA on JI with an erosion marker for long-term monitoring. The geotextile liner option was rejected because it would pose a hazard to fish and wildlife when the seawall fails and the liner is exposed to the lagoon or the environment. The DTRA followed the Resource Conservation and Recovery Act process by using performance criteria and evaluation criteria to evaluate the possible options available. The DTRA has studied the potential impacts to the environment (groundwater, air, and biota). Plutonium oxide on JA does not solubilize in groundwater, does not have significant uptake in marine biota, and poses no ingestion route and no hazard from biota consumption to humans. These factors, coupled with the islands' remote location and missile abort history, support this conclusion.

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Item ID Number 04232 ☐ **Not Scanned**

Author

Corporate Author

Report/Article Title Notes, memranda, reports: Johnston Island Studies

Journal/Book Title

Year 0000

Month/Day

Color ☐

Number of Images 127

Descripton Notes Items were filed together in a binder labelled, "78-8D JI Studies"

ROUTING SLIP	DATE 21 Jul 80

ACTION	INFORMATION
	MAJ YOUNG USAF SAM/EKO STOP 34

ROUTING	OFFICE	INITIALS	COMMENTS
	CC		
	CV		
	SU		
	EC		ARTHUR P. CALDWELL, COL USAF BSC CHIEF, CONSULTANT SERVICES DIV
	QE		
	SA		
	RZ		
	JAG		

OEHL FORM AUG 77 10

Memo For The Record

18 JUL 1980

Subject: Telephone Inquiry From HQ DNA, Kirtland AFB, NM

AV 221-7132

TO: Col Caldwell

I was called by Mr. Stevens (AV 221-7132) Concerning what Type of environmental monitoring The AF had done at JI since 1977 when H.O. was removed. I explained our environmental monitoring program and stated That a report of That monitoring was forth coming.

The main question asked, Is it safe for radiation monitoring people To go into The old Storage area To collect soil samples for back ground radiation monitoring? If so do They need protective Clothing? I said it was no problem To go into The area. The only reason it is blocked off now is prevent vehicular tracking of H.O. & Dioxin

People should wear protective disposable cover-alls and rubber gloves when They are in contact with The Soil.

Other questions

Is H.O. Degrading? Slowly
Is Dioxin Degrading? very very slowly we Think
Is There Dioxin in The water (ocean)? NO
Has There been a safe level established for Dioxin in Drinking water? NO

How much of the area is contaminated?
Approximately 1 acre of 12.5 acres

No mention was made of any other Topics or the material stored in the Bunker.

C E Thalken

CHARLES E. THALKEN LtCol, USAF BSC
Chief, Environmental Assessment Branch

Questions

1. Do you want any more samples run?
Nebraska has 34 slots remaining

7 Samples are Eglin soils
12 Samples are Eglin plant uptake study
14 Samples are NCBC biologicals
1 Sample is a mouse Tissue Sample from Eglin

The 14 biologicals from NCBC are the samples That Major Bill Cairney hand carried upto To USAFA.

They are 7 biologicals from The site collected in Jun 1979 and seven are from These sites and Locations

B-1 - Turtle Fat site
B-2 - Turtle Fat 1600'
B-13 - Turtle Fat 5000'

B-4 - Crayfish/Fish 9000'
B-5 - Frog/Fish 12000'

2. Should we go with what we have?
Publish the TR ASAP with the data on hand?

3. Commander Bob Peterson
Entomologist at Navy Surgeons office
Asking questions about NCBC
Claims local Newspapers stirring pot

Capt McHue NCBC
Asking questions

4. JI Samples contaminated to 24 cm
Any resampling?

HERBICIDE ORANGE SITE MONITORING PROJECT

STATUS: 1 November 1979

CONTRACTUAL STATUS

Department of Agonomy and Soils, Washington State University, Pullman WA (Dr. H.H. Cheng, 9.925K). Final Report submitted in technical report format 31 Oct 79 (Recipt Pending).

Flammability Research Center, University of UT (Mr. William McClennen, 82K). Final Report submitted 1 Nov 79 (Receipt Pending).

Department of Chemistry, University of Nebraska, Lincoln NE (Dr. Michael Gross, 41.25K). Interim Report submitted on 41 samples 6 Sep 79). Report on the remaining 34 samples due NLT 31 Dec 79.

IN-HOUSE STUDIES STATUS

USAFSAM/NG (Lt Col Eugene Arnold). Final Report submitted in draft 1 Oct 79, onn "Analysis of Herbicide Orange Components in Selected Soil Samples".

USAFA/DFCBS (Maj William C. Cairney, 19K). Final Report submitted in draft 1 Oct 79 on "Results of Environmental Monitoring of Sites Previously Used for Long-term Storage of Phenoxy Herbicides: Summary of Microbiological Findings".

TECHNICAL REPORTS STATUS

Outline submitted 1 Sep 79
Draft in Progress
Draft to be completed & typed NLT 15 Nov 79
Final Technical Report for Review -- Dec 79
Submission to AFSC/SG and AFLC/LO ---- Jan 80

1980 FUNDING

Statement of Work for Project Order to USAF Academy Prepared 26 Oct 79

HO Sample and Analytical Residue Waste Materials
To Be Disposed

1. USAFSAM/NGP - Lt. Col. Arnold - None

2. Washington State University - Dr. Cheng - None

3.* University of Nebraska - Dr. Gross - 1 - Sealed 5 gal can; of Soil Samples and ½ gal of liquid extract
No gloves, glassware, bench Top material

4.* University of Utah - Mr. McClennon - 4 - sealed 5 gal cans; of soil samples, glassware, gloves, bench Top materials and 5 gal of liquid extract

5. USAF Academy - Major Cairney - 1 - sealed 5 gal can; of soil samples from U of Utah last years contract.

* U of Nebraska and Utah have written into their contracts the statement that all unused samples and laboratory extracts and laboratory support materials (ie glassware, gloves, wipes, etc) will be held until further direction by USAF OEHL or returned to USAF OEHL for final disposal.

02 NOV 1979

Tentative Conclusions

1. No TCDD degradation over 2 yrs

2. 2,4-D & 2,4,5-T acid and n-butyl esters rapidly degraded

3. Iso and normal octyl esters of 2,4-D and 2,4,5-T very persistent

4. Evidence of silt/TCDD movement at NCBC

up to 1,000 FT from storage site

Utah has examined Jun 79 NCBC sediments

2.0 to 3.6 ppb (at a DL of 0.5-2.0 ppb)

Nebraska has examined Jan 79 NCBC sediments

20 ppt at 5000 FT the Base Fence (DL of 10 ppT)
ND at 9000 FT off Base (DL of 10 ppT)

5. Nebraska has looked at Crayfish at 5000 FT
45 ppT (DL 10 ppT)
(Formerly 18 ppT at a DL of 15 ppT)
Crayfish at 9000 FT
20 ppt (DL 10 ppT)

HERBICIDE ORANGE SITE TREATMENT AND ENVIRONMENTAL MONITORING

REPORT AND RECOMMENDATIONS

FOR

FIELD COMMAND DEFENSE NUCLEAR AGENCY
JOHNSTON ISLAND, PACIFIC OCEAN

PREPARED FOR

AIR FORCE LOGISTICS COMMAND
WRIGHT -PATTERSON AFB OH

PROGRAMMING PLAN 75-19, ANNEX 8 FOR THE
DISPOSAL OF HERBICIDE ORANGE

UNITED STATES AIR FORCE
OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY
BROOKS AFB TX 78235

TECHNICAL REPORT OUTLINE

I. INTRODUCTION

LIST OF OBJECTIVES

II. PROTOCAL

SAMPLING SCHEME AND ANALYTICAL PROGRAM

III. RESULTS

A. MAGNITUDE OF CONTAMINATION

B. SOIL PERSISTENCE

C. FATE OF RESIDUE ON STORAGE SITE

D. FATE OF RESIDUE OFF STORAGE SITE

E. MICROBIAL DATA

IV. DISCUSSION OF DATA

A. CONCLUSIONS FROM DATA

B? PROPOSED MANAGEMENT TECHNIQUES FOR STORAGE SITES

C. RECOMMENDATIONS FOR USE OF SITE

VI RECOMMENDATION FOR FUTURE STUDIES

PHOTOGRAPHS OF THE SITE AND A MAP SHOULD BE INCLUDED

OBJECTIVES OF THE HERBICIDE ORANGE SITE MONITORING STUDY

1. To determine the magnitude of contamination of the storage site.
2. To determine the soil persistence of phenoxy herbicides, degradation products and TCDD.
3. To determine the fate of Herbicide Orange and TCDD in the storage area.
4. To monitor movement of residues from the site into water, sediments and biological organisms.
5. To determine the effects of residues on biological organisms.
6. To recommend managerial techniques for minimizing the impact of herbicides and TCDD residues on the ecology and human population adjacent or near the storage site.
7. To recommend options for use(s) of the storage area.

DATA SOURCE FOR MEETING OBJECTIVES:

Objective 1. University of Utah and USAF SAM/NGP (Sample analyses)

Objective 2. University of Utah and USAF SAM/NGP (Sample analyses)

Objective 3. University of Utah, USAF SAM/NGP, University of Hawaii, Washington State University (Soil Core and Laboratory Data)

Objective 4. University of Nebraska, University of Utah, Wright-State University and USAF OEHL/SA data

Objective 5. Department of Chemistry and Biological Sciences, USAF Academy

4/14

T. TEST 4L 0%

Johnston Island

FIRST

5	0.019	0.041
9	0.029	0.053
# 10	0.235	0.119
12	0.111	0.081
24	0.024	0.064
26	0.003	0.011
30	0.036	0.040
34	0.152	0.150
36	0.019	0.140
39	0.041	0.080
40	0.053	0.034
41	0.127	0.120
42	0.020	0.021

14) 66.85 14) 74.9

JOHNSTON ISLAND SAMPLING PROTOCOL
AUGUST 1979

OBJECTIVE: To collect water, sediment and coral samples in selected locations at Johnston Island in support of the Herbicide Orange Site Monitoring Project.

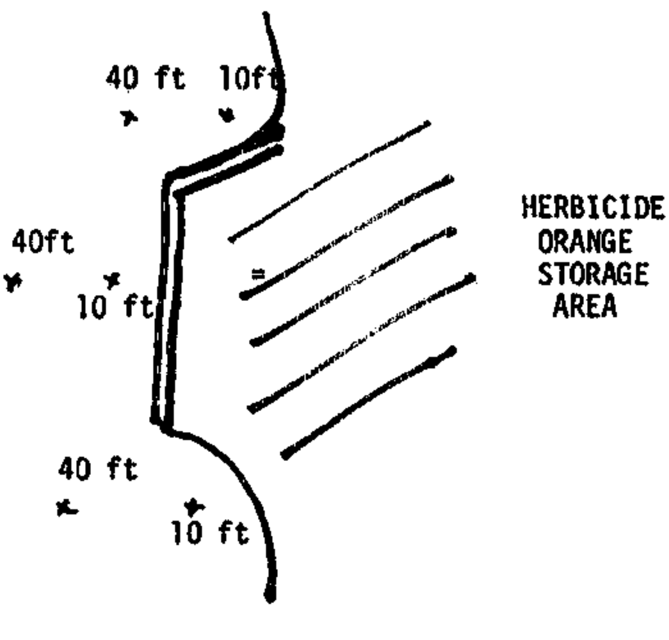
Total Number of Samples to be collected = 35

SAMPLE COMPOSITION AND PROTOCOL

Water: Five (5) 1 liter water samples should be collected at key sites on and around the Island. At least one sample should come from an area adjacent to the storage site. The location previously sampled by the Base Medical Staff should suffice. The samples should be collected in a 1 liter dark bottle with tight cap(aluminum insert). The bottle should be Number(by location), dated as follows:

JI-100	Water Sample Location : Ten feet Off shore line Near drainage pipe adjacent HO Storage Date: 7 Aug 1979 Johnston Island USAF OEHL/ECE

SEDIMENT: Two (2) sediment samples should be collected adjacent (off-shore) of Herbicide Storage area. The samples should represent at least three subsamples and should be approximately the top 8 cm (8 x 8 x 8cm) of sediment.



The three samples collected 10 feet from shore should be composited, dried, thoroughly mixed, crushed, and selved so as to pass through a #14 sieve. It should be subsampled into two 2 oz jars, appropriately labelled. One jar is to be sent to the FRC, University of Utah, and one jar to the USAF ACADEMY.

The three samples collected 40 feet from shore should be handled in the same manner.

Soil Cores: Two soil cores should be collected from selected sites on the Herbicide Storage area. The two sites selected are JI-10 and JI-37. Samples should be taken 15 cm from the Nail and Metal Label indicating site. Samples are to be collected in the following increments:

0 - 2 cm	8 - 12 cm
2 - 4 cm	12 - 16 cm
4 - 6 cm	16 - 20 cm
6 - 8 cm	20 - 24 cm

Each sample should be collected from an area of approximately 2 x 12 x 12 cm (D x L x W) and should be removed by sampling from the side of a ditch (See Figure 1). The ditch must be on the side away from the stake.

After carefully removing the increments, they should be dried, thoroughly crushed, and mixed. The sample should be sieved through a # 14 sieve. The sample should be subsampled into two 2 oz jars, appropriately labelled, and a sniff test conducted on it prior to sealing and preparation for shipment.

The sniff test should be conducted by at least two people in the following manner:

0 = no odor detectable

1 = Trace
2 = Mildly irritating
3 = Strong & irritating

The samples should be shipped to FRC & USAFA.

JI-10 Soil Sample
Depth: 0 - 2 cm
Date: 7 August 1979
Johnston Island
USAF OEHL/ECE

FIGURE 1. TECHNIQUE FOR OBTAINING SOIL INCREMENTS FOR PENETRATION STUDIES.

PHOTOGRAPHS OF ALL SITES AND AN OVERALL PHOTO OF THE AREA SHOULD BE TAKEN!!

SOIL SAMPLES: Twelve (12) samples should be obtained from areas where spills occurred. The selected sites are:

- JI-5
- JI-9 H/H
- JI-12 H/H
- JI-24 L/L
- JI-26 L/L
- JI-30 L/L
- JI-34 L/L
- JI-36 H/H
- [redacted]
- JI-39 H/H
- JI-40 H/H
- JI-41 H/H
- JI-42 H/H

Each Sample should be collected 15 cm from the appropriate stake, and should be a 8 x 8 x 8 cm increment. It should not be in a depression which has been previously sampled. The old sampling sites are visible !

Each sample should be dried, crushed, mixed, sieved, evaluated with a sniff test, and subsampled into two 2 oz jars.

SHIPMENT OF SAMPLES:

The 5 water samples, one set of sediment samples (2), a set of the core samples (16), and a set of the soil samples (12) should be sent to:

FLAMMABILITY RESEARCH CENTER
ATTN: MR. W. H. McCLENNEN
UNIVERSITY OF UTAH
391 SOUTH CHIPETA WAY
P.O. Box 8089
SALT LAKE CITY, UTAH 84108

(801) 581-8431

One set of sediment samples (2), a set of core samples (16), and s set of soil samples (12) should be sent to:

MAJOR WILLIAM J. CAIRNEY
USAFA/DFCBS-R
USAF ACADEMY COLORADO 80840
(303) 472-2720

IF THE SAMPLES CAN BE SHIPPED IMMEDIATELY UPON ARRIVAL AT HICKHAM AFB, THEY NEED NOT BE REFRIGERATED. HOWEVER, THEY SHOULD (especially the water samples) be kept under refrigeration until shipment can be made. SHIP SAMPLES AIR EXPRESS. DO NOT FREEZE.

HO STORAGE SITE TREATMENT AND ENVIRONMENTAL MONITORING

Report and Recommendations

FOR NCBC Gulfport MS

Prepared For

Air Force Logistics Command

Programming Plan 75-19, ANNEX 8

FOR THE

DISPOSAL OF ORANGE HERBICIDE

Introduction
List of Objectives

Protocol
Sampling Scheme

Results
1. <u>Magnitude of Contamination</u> -

2. <u>Soil Persistence</u>

3. <u>Fate of Residue</u> on Site
Movement

4. ~~Fat~~ Movement off site

5. Microbial Data

Discussion
Conclusions from data
Proposed Managerial techniques
Recommend for Use
Recommendations for Future Studies

Objectives

Hap/ Mason 1. to determine the magnitude of contamination of the storage site.

Hap/ Mason 2. to determine the soil persistence of herbicides, degradation products and TCDD.

Soil Co/ Mike 3. to determine the fate of HO/TCDD in the storage area.

[illegible] 4. to monitor movement of residues from the site - water, soil (sediment & biologic.)

[illegible] 5. to ~~[illegible]~~ determine the effects of residue on biological organisms

6. to recommend managerial techniques for minimizing the impact of residues.

7. To recommend options for use of the storage area.

AIR FORCE LOGISTICS COMMAND

PROGRAMMING PLAN 75-19

FOR THE

DISPOSAL OF ORANGE HERBICIDE

PREPARED BY
SAN ANTONIO ALC ATCH 25

APRIL 1977

ANNEX 8

STORAGE SITE TREATMENT

AND MONITORING

INTRODUCTION

1. INFORMATION REGARDING THE STORAGE SITES AND ENVIRONMENTAL CONDITIONS OF THE SURROUNDING AREA AT NAVAL CONSTRUCTION BATTALION CENTER (NCBC) GULFPORT MS AND JOHNSTON ISLAND (JI) WAS PRESENTED IN FIVE TRIP REPORTS AS FOLLOWS: EHL(K) LETTER 30 OCT 73, "INITIAL TRIP REPORT JOHNSTON ISLAND WATER POLLUTION SURVEY (30 SEP-4 OCT)"; USAF ACADEMY HANDOUTS TO HERBICIDE ORANGE CONFERENCE ON 21-22 AUG 74, "TRIP REPORT - GULFPORT, MISSISSIPPI/ HOUSTON, TEXAS, 1-2 JULY 1974" AND "TRIP REPORT, UNIVERSITY OF HAWAII AND JOHNSTON ISLAND" 30 JUL - 6 AUG 74; EHL(K) LETTER 1 OCT 74, "TRIP REPORT - NCBC, GULFPORT MS - MAJ INMAN" AND EHL(K) LETTER, 4 AUG 75, "MEETING WITH REGION IV, EPA REPRESENTATIVES, 23 JUNE 1975, REGARDING STORAGE/MAINTENANCE OF ORANGE HERBICIDE AT NCBC, GULFPORT MS." THE LATTER INCLUDED REPRESENTATIVES OF EPA REGION IV, EPA PESTICIDE LAB, ATHENS GA AND EHL(K). THESE REPORTS REVEALED THAT THERE IS HERBICIDE CONTAMINATION THROUGHOUT THE STORAGE AREAS, BUT NO ADVERSE ENVIRONMENTAL EFFECTS WERE NOTED IN THE SURROUNDING AREAS. ALTHOUGH LEAKAGE FROM DRUMS OF HERBICIDE IN STORAGE DOES OCCUR THERE IS NO CONTINUOUS RUNOFF OF HERBICIDE INTO THE DRAINAGE DITCHES WHICH DRAIN THE STORAGE AREA. WHEN THE LEAKED HERBICIDE BECOMES ABSORBED INTO THE SOIL IN THE LEAKED AREA, IT IS DIFFICULT, DUE TO LOW SOLUBILITY AND DENSITY OF THE HERBICIDE FOR NORMAL RAIN WATER RUNOFF TO TRANSPORT THE HERBICIDE TO THE DRAINAGE DITCHES. UNFORTUNATELY, IF A LEAK OCCURS DURING A RAIN STORM OR THERE IS UNABSORBED HERBICIDE ON THE GROUND DURING A RAIN STORM, THE TRANSPORT OF HERBICIDE TO DRAINAGE DITCHES CAN OCCUR. BOTH THE NCBC AND JI STORAGE AREAS ARE UNDER CONSTANT SURVEILLANCE.

2. THE DE-DRUMMING AND TRANSFER OPERATIONS DESIGNED FOR INCORPORATION AT BOTH STORAGE SITES SHOULD NOT CAUSE FURTHER CONTAMINATION OF THE STORAGE AREAS BECAUSE THESE OPERATIONS HAVE BEEN PLANNED TO MINIMIZE THE SPILLAGE OF ORANGE HERBICIDE. IN ADDITION, PROCEDURES AND MATERIALS ARE READY TO INSURE CONTAINMENT AND/OR COLLECTION OF THE HERBICIDE IF A SPILL SHOULD OCCUR.

STORAGE SITE CLEAN-UP

STORAGE SITE CLEAN-UP CAN BE MINIMAL IN UNDISTURBED AREAS BECAUSE BIODEGRADATION OF HERBICIDE WILL OCCUR IN THE SOIL. AT JOHNSTON ISLAND THE CORAL SOIL OF THE ISLAND READILY ABSORBS ORANGE HERBICIDE. THIS ABSORPTIVE CAPACITY OF THE COMPACTED CORAL WITHIN THE STORAGE SITE HAS CONFINED SPILLED HERBICIDE TO THE UPPER 12 - 18 INCHES OF SOIL AND WITHIN THE IMMEDIATE AREA OF THE SPILL. CLEAN-UP OF THE STORAGE SITE CAN BE ACCOMPLISHED BY COVERING THE AREA WITH CLEAN CORAL AND COMPACTING TO CONTROL ANY POSSIBILITY OF HERBICIDE RUNOFF OR RESUSPENSION DURING IN SITU BIODEGRADATION. AT NCBC, THE SOIL AT THE STORAGE SITE HAS BEEN TREATED WITH CEMENT AND COMPACTED. THIS TREATMENT HAS CREATED A 12 - 18 INCH LAYER OF CEMENT/SOIL WHICH IS RELATIVELY IMPERVIOUS TO WATER AND HERBICIDE; HOWEVER, THE LAYER IS ABOUT THREE INCHES BELOW THE GROUND SURFACE. THE UPPER THREE INCH LAYER IS SIMILAR TO THE NORMAL SOIL OF THE AREA WHICH APPEARS TO BE A SANDY CLAY. THIS SITE SHOULD BE COVERED WITH A MATERIAL SUCH AS OYSTER SHELLS AT THE COMPLETION OF THE DE-DRUMMING AND TRANSFER OPERATION. ADDITIONAL CLEAN-UP PROCEDURES AT BOTH NCBC AND JI MAY BE NECESSARY IF A FACILITY IS TO BE CONSTRUCTED ON EITHER STORAGE SITE. THE EXACT NATURE OF THE CONSTRUCTION, I.E., DINING HALL, WAREHOUSE, OFFICE BUILDING, ETC., WILL DETERMINE THE EXTENT OF ADDITIONAL CLEAN-UP PROCEDURES REQUIRED. PRIOR TO COMMENCEMENT OF ANY CONSTRUCTION, SOIL SAMPLES WILL BE COLLECTED AND ANALYZED FOR ORANGE HERBICIDE CONSTITUENTS. IF HERBICIDE IS DETECTED, IT MAY BE NECESSARY TO REMOVE THE SOIL AND DISPOSE OF IT IN AN APPROVED SANITARY

LANDFILL. BEFORE REMOVAL OF ANY SOIL, IT WILL BE TREATED WITH OIL TO PREVENT AIRBORNE SUSPENSION OF DUST PARTICLES WHICH MAY CONTAIN ABSORBED HERBICIDE OR ITS CONSTITUTENTS. THE PROCEDURES WILL BE DEVELOPED WITH THE CONCURRENCE OF CONCERNED AGENCIES.

SITE MONITORING

SOIL SAMPLES FROM THE STORAGE SITES AT BOTH NCBC AND JI WILL BE COLLECTED AND ANALYZED FOR ORANGE HERBICIDE AFTER THE COMPLETION OF TRANSFER OPERATION. THESE ANALYSES WILL AID IN THE ESTABLISHMENT OF A SCHEDULE FOR FUTURE MONITORING. THE SITE MONITORING PROGRAM WILL BE CONCLUDED UPON MUTUAL AGREEMENT OF ALL AGENCIES INVOLVED. AS INDICATED ABOVE, THE MONITORING PROGRAM WILL BE FLEXIBLE TO REQUIREMENTS GENERATED BY CONSTRUCTION OF ANY FACILITY ON THE STORAGE SITE. THE CURRENT "ORANGE HERBICIDE" WATER MONITORING PROGRAM AT JI WILL BE CONTINUED UNTIL ALL AGENCIES CONCERNED DETERMINE THAT IT CAN BE CONCLUDED.

22 JUN 79

Johnston ISLAND Project

1. SEARCH RECORDS of ANALYTICAL DIVISION (SA) for data on Herbicide Concentrations in WATER of JI

2. Plot data over time. NOTE EARLIER data prepared by Maj Tremblay and Statistical comparisons.

3. Reanalyzed data per method in (2).

4. Prepare brief report FOR FC DNA.

ALY
ALVIN L. YOUNG, Major, USAF
Consultant, Environmental Sciences

22 JUNE 79

Discussed above project with Maj Fishburn and Mark Willis. Mr Willis will immediately initiate project in response to attached memo. He will coordinate his search & methods with Maj Tremblay.

ALY

EC Muncy
ECE Cat 14 6/79
Maj Young Aly 20 JUN 1979

Coordinated with Fishburn

Talked c̄ Dr. Bramlet FCDNA, (AV 964-6487) today. He asked about 1) TCDD Carbon cylinders @ JI

2) Site monitoring results

3) Env. water sampling program

1) Told him we (OEHL) have not been tasked to look into cylinders & disposition — gave him AFLC/Ron Whaler's tel. no. Did mention to him that Hughes had run irradiation test.

2) Told him the analyses of site monitoring samples were incomplete and that we expected to have to take yet another set of samples.

3) Mentioned to him that we'd look into results of quarterly ambient water sampling and when we draw a bottom line on site reclamation

work, we'd also have something to offer on the future need of ambient water sampling

(I)

Mr. George Meisner
J.I. Power Plant
Manager

For Large Color
Enlargement of
J.I. Aerial PhoTo.

Can we order some of Them? Would like To send ~~some~~ money For 10-15 enlargements? Will George get The copies for us and Send Them To This Lab.

Chuck Thielen

Phil Roseberry
Bill Sonoby

Please contact Mr. George Meisner
at Power Plant
Ask about J.A. Color
Photo

Autovon Numbers OP. Assist.

259-3111 USAF Academy CO
240-1110 Brooks AFB TX
471-1110 FT Sam Houston TX
487-1110 Randolph AFB TX

Dial operator at J.A. - at a Time other Than 1600-1800 Hrs
Ask For moral & welfare call To be placed To AV number
in states - Be sure To identify To state side operator
This is a moral & welfare call From J.A.

Dial 99 From class A phone at J.A. To get Honolulu

Major Gibeau 449-9433 Duty
422-1523 Home

Hickam Ops 422-0531
Tropic Isle Hotel 923-3141

Washington Switch 937-1550
AC 202-245-3048

Weather J.A. 2310

Colony Surf Travel - Diane Hamilton - Travel Consultant
2895 KalaKaua Ave.
Honolulu, Hawaii
808-922-2311

TELECOPY AUTOVON 363-2495

OCTOBER 13, 1981

FOR: PUBLIC AFFAIRS OFFICER
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI
AUTOVON 363-2393

FROM: OFFICE OF PUBLIC AFFAIRS
HEADQUARTERS AIR FORCE ENGINEERING AND SERVICES CENTER
TYNDALL AIR FORCE BASE, FLORIDA 32403
AUTOVON 970-6476

HQ AFESC/CC RF

HQ AF/LEE RF

HQ AFESC/RDV FILE

HQ AFESC/PA FILE

FOR TRANSMITTAL TO MR. JIMMIE BELL, BILOXI DAILY HERALD:

WE APPRECIATE YOUR DESIRE TO PREPARE AN ACCURATE NEWS STORY ON THE HERBICIDE ORANGE MONITORING PROGRAM AT GULFPORT. WE UNDERSTAND THAT IN THE INTEREST OF ACCURACY YOU MAY ASK US TO REVIEW YOUR ARTICLE---WE WILL BE HAPPY TO ASSIST IN ANY WAY WE CAN.

YOUR POINT OF CONTACT ON ALL MATTERS REGARDING THIS SUBJECT IS THE PUBLIC AFFAIRS OFFICER AT THE NAVAL CONSTRUCTION BATTALION CENTER, MS. JACKIE DEVINE. WE WILL WORK CLOSELY WITH HER TO RESPOND PROMPTLY TO ANY ADDITIONAL QUERIES YOU MAY HAVE.

WE ARE SENDING YOU BY MAIL COPIES OF HERBICIDE ORANGE STUDIES DONE BY THE AIR FORCE OCCUPATIONAL AND ENVIRONMENTAL HEALTH LAB AT BROOKS AIR FORCE BASE, TEXAS. WE FEEL THESE STUDIES MAY BE HELPFUL AS YOU PREPARE YOUR ARTICLE.

THE FOLLOWING ARE RESPONSES TO YOUR QUESTIONS OF SEPTEMBER 30, 1981:

QUESTION: WHEN WAS THE MONITORING FIRST ORDERED FOR THE GULFPORT CENTER AS IT RELATES TO THE STORAGE OF AGENT ORANGE AT THE CENTER?

RESPONSE: VARIOUS AIR FORCE AND CONTRACT LABORATORIES HAVE BEEN CONDUCTING ENVIRONMENTAL SURVEYS AND ANALYSES OF THE SOILS, PLANTS, AND THE AQUATIC SYSTEMS IN AND AROUND THE HERBICIDE ORANGE STORAGE AREA SINCE 1970. THE OBJECTIVES OF THIS MONITORING ARE TO ASSURE THAT CONTAMINATION IS CONTAINED AND POSES NO HEALTH RISK, AND TO DETERMINE IF NATURAL DEGRADATION IS OCCURRING AND AT WHAT RATE. (SEE OEHL TR-79-169, PAGES 7-16 AND 24-30)

COORDINATION: RDV [signature]
RD [signature]
DEVP [signature]
DEV [signature]
JA [signature] (14)

PAM [signature]
PAX [signature]

Cy to SAF/PAM (Capt Stetson-Mannix)
Keesler AFB/PA

QUESTION: HOW WAS THE MONITORING FUNDED? THROUGH WHAT FEDERAL PROGRAM? COST?

RESPONSE: THE DEPARTMENT OF DEFENSE HAS FUNDED VARIOUS PROGRAMS AT THE CENTER INCLUDING INITIAL SITE MONITORING, REDRUMMING OF THE ENTIRE INVENTORY IN 1972, THE AT-SEA INCINERATION OF HERBICIDE ORANGE IN 1977, AND THE PRESENT SITE MONITORING. CURRENT COST FOR THE SITE MONITORING AND EVALUATION AT GULFPORT IS APPROXIMATELY $20,000 YEARLY. (SEE OEHL TR-79-169, PAGES I-II AND 7-16)

QUESTION: HOW IS IT PHYSICALLY CARRIED OUT, SPECIFICALLY AS TO EQUIPMENT, PERSONNEL, AND TIME REQUIRED?

RESPONSE: SOIL SAMPLES ARE OBTAINED BY REMOVING A 12 X 12 X 3 INCH DEEP SAMPLE USING A HAMMER AND CHISEL, SIEVING THE SOIL TO REMOVE ROCKS, AND PLACING THE SOIL IN AN ALL-GLASS CONTAINER WITH AN ALUMINUM-LINED LID. SEDIMENT SAMPLES ARE TAKEN FROM DRAINAGE DITCHES, AND BIOLOGICAL SAMPLES---SUCH AS MINNOWS, TADPOLES, ETC.--- ARE TAKEN WITH A DIP NET. SEDIMENT SAMPLES AND BIOLOGICAL SAMPLES ARE SIMILARLY PLACED IN ALL-GLASS JARS WITH ALUMINUM-LINED LIDS. IT TAKES TWO DAYS FOR ONE PERSON TO COLLECT THE SAMPLES NEEDED.

QUESTION: WHAT TYPE SAMPLES ARE OBTAINED?

RESPONSE: SOIL SAMPLES ARE TAKEN FROM THE STORAGE SITE. SEDIMENT AND BIOLOGICAL SAMPLES ARE TAKEN FROM THE DRAINAGE DITCH SYSTEM.

QUESTION: HOW OFTEN ARE SAMPLES OBTAINED?

RESPONSE: SEMIANNUALLY. THE NEXT SAMPLING IS NOVEMBER--DECEMBER 1981.

QUESTION: DOES THE MONITORING EXTEND BEYOND THE CONFINES OF THE CENTER? DOES IT GO INTO NEIGHBORHOODS IN SURROUNDING AREAS?

RESPONSE: SAMPLING POINTS IV AND V EXTEND BEYOND THE CONFINES OF THE CENTER. SAMPLING SITE IV IS 9,000 FEET FROM THE STORAGE AREA WHERE THE DRAINAGE DITCH ENTERS CANAL NUMBER ONE. SAMPLING SITE V IS 12,000 FEET FROM THE STORAGE AREA WHERE CANAL NUMBER ONE ENTERS TURKEY CREEK. (SEE OEHL TR-79-169, PAGE 26)

QUESTION: PLEASE PUT IN WRITING THAT VEGETATION GROWS WHERE THE AGENT ORANGE WAS LOCATED. ALSO PLEASE CONFIRM IF TOMATO PLANTS TO THE SOUTH OF THE CENTER HAVE EVER BEEN KNOWN TO WILT OR DIE AS A RESULT OF THE STORAGE OF THE DEFOLIANT AT THE CENTER.

RESPONSE: TOMATO PLANTS ARE AMONG THE MOST SENSITIVE PLANTS TO THE CHEMICALS IN HERBICIDE ORANGE. DURING THE DEDRUMMING OPERATION IN 1977, TEST TOMATO PLANTS AROUND THE SITE AT 1,000 FEET SHOWED SLIGHT TO MODERATE DAMAGE. PLANTS AT A GREATER DISTANCE SHOWED ONLY MINIMAL DAMAGE. NO INSTANCES OF TOMATO PLANT DAMAGE FROM HERBICIDE ORANGE SOUTH OF THE CENTER, OFF THE INSTALLATION, ARE KNOWN. YES, VEGETATION IS GROWING WELL ON THE FORMER HERBICIDE ORANGE STORAGE SITE AND IN THE ASSOCIATED DRAINAGE SYSTEM.

QUESTION: PLEASE PUT IN WRITING THAT AGENT ORANGE WAS NAMED FOR THE STRIPE ON THE CAN IN WHICH IT WAS STORED, AND IS ACTUALLY A DARK, REDDISH BROWN.

RESPONSE: HERBICIDE ORANGE IS A REDDISH-BROWN TO TAN COLORED LIQUID. IT WAS FORMULATED TO CONTAIN A 50:50 MIXTURE OF THE N-BUTYL ESTERS OF 2,4-DICHLOROPHENOXYACETIC ACID (2,4-D) AND 2,4,5-TRICHLORO-PHENOXYACETIC ACID (2,4,5-T). BECAUSE OF THIS COMPLEX NOMENCLATURE, IT WAS IDENTIFIED WITH AN ORANGE STRIPE ON DRUM CONTAINERS. OTHER HERBICIDES WERE IDENTIFIED WITH DIFFERENT COLOR STRIPES.

QUESTION: PLEASE EXPLAIN WHAT IS ACTUALLY BEING SOUGHT IN THE STUDIES AS IT RELATES TO IMPURITIES. YOUR TECHNICAL JARGON (REFERRING TO CONVERSATION WITH AIR FORCE CAPTAIN CHANNELL) IS MORE ACCURATE SOUNDING THAN MY INTERPRETATION OF WHAT YOU SAID.

RESPONSE: THE EFFECTIVENESS OF PHENOXY HERBICIDES (2,4-D AND 2,4,5-T) AS PLANT GROWTH REGULATORS WAS DETERMINED IN 1944. THE OUTSTANDING EFFECTIVENESS OF THESE TWO HERBICIDES IN CONTROLLING THE GROWTH OF BROAD-LEAVED PLANTS AND WEEDS, COUPLED WITH THEIR LOW MAMMALIAN TOXICITY AND LOW APPLICATION RATES, RESULTED IN THEIR RAPID ACCEPTANCE IN WORLD AGRICULTURE AND BY UTILITY COMPANIES IN MAINTAINING RIGHTS-OF-WAY.

THE FIRST MILITARY SHIPMENTS OF HERBICIDES (PURPLE AND BLUE) WERE RECEIVED IN VIETNAM IN JANUARY 1962. IN APRIL 1970 THE SECRETARIES OF INTERIOR AND HEALTH, EDUCATION AND WELFARE JOINTLY ANNOUNCED THE SUSPENSION OF CERTAIN USES OF 2,4,5-T SINCE STUDIES INDICATED 2,4,5-T WAS A TERATOGEN. SUBSEQUENT STUDIES SHOWED THE TERATOGENIC EFFECTS CAME FROM A TOXIC CONTAMINANT IN 2,4,5-T IDENTIFIED AS 2,3,7,8-TETRACHOLORODIBENZO-P-DIOXIN (TCDD OR DIOXIN).

AS A RESULT, THE DEFENSE DEPARTMENT SUSPENDED THE USE OF HERBICIDE ORANGE. AT THE TIME OF SUSPENSION, THE AIR FORCE HAD AN INVENTORY OF 0.85 MILLION GALLONS AT THE GULFPORT NCBC. THIS MATERIAL REMAINED IN STORAGE UNTIL 1977, AWAITING AN ENVIRONMENTALLY SAFE AND EFFICIENT MANNER OF DISPOSAL.

DURING THIS TIME SOME LEAKAGE OCCURRED, RESULTING IN SOIL CONTAMINATION AT THE STORAGE SITE. WE ARE CONCERNED ABOUT THE TCDD,

AND ARE MONITORING THE SITE TO ASSURE OURSELVES AND THE PUBLIC THAT IT IS INDEED CONTAINED AND CONTROLLED, AND THAT IT IS DEGRADING NATURALLY.

ONLY ABOUT ONE TO TWO ACRES OF THE TWELVE ACRE STORAGE SITE WAS FOUND TO BE CONTAMINATED IN THE 1979 STUDY. (SEE OEHL-TR-79-169, PAGE 31) ACCORDING TO THE REPORT, TCDD LEVELS AT THAT TIME WERE DECREASING.

SINCE THAT REPORT, WE HAVE STABILIZED THE DRAINAGE DITCHES WITH GRAVEL TO PREVENT SOIL EROSION, AND WE HAVE INSTALLED SILT TRAPS.

ACTIONS WE HAVE TAKEN BASED ON RECOMMENDATIONS IN THE 1979 STUDY (SEE OEHL TR-79-169, PAGES 32 AND 33) APPEAR TO BE WORKING.

-30-

FOR PUBLIC AFFAIRS OFFICER, NCBC GULFPORT: THANKS FOR YOUR HELP. WE WILL WORK WITH YOU SHOULD ADDITIONAL QUERIES DEVELOP. ACTION OFFICERS HERE AT THIS HEADQUARTERS ARE LT MATTHEW DURHAM, CHIEF OF MEDIA RELATIONS, AND CAPTAIN DAVID L. GEARY, DIRECTOR OF PUBLIC AFFAIRS.

END OF TELECOPY

0800 — 9-30-81

Media Relations Department
Tyndall Air Force Base
Tyndall, Fla.

Sirs: Capt. Ronald E. Channell, in response to our request for information on the monitoring pro gram at Gulfport (Miss.) Naval Seabee Center, has requested that I submit the following questions through your office.

If you will submit these to Capt. Channell for his answers and submit the answers to us in writing, it will be [illegible] most helpful in preparing an accurate news story [illegible] for our newspaper.

1. When was monitoring first ordered for the Gulfport center as it relates to the storage of agent orange at the center?

2. How was the monitoring funded? Through what federal program? Cost?

3. How is it physically carried out, specifically as to equipment, personnel and time required?

4. What type samples are obtained?

5. How often are samples obtained?

6. Does the monitoring extend beyond the confines of the center? Does it go into neighborhoods in surrounding areas?

7/ Please put in writing that vegetation grows where the agent orange was located. Also please confirm if tomato plants to the south of the center have ever been known to wilt or die as a result of the storage of the defoliant at the center .

8. Please put in writing that agent orange was named for the [illegible] stripe on the can in which it was stored and is actually a dark, rusty reddish brown.

9. Please explain what is actually being sought in the studies as relates to the impurities. Your technical jargon is more accurate [illegible] sounding than my interpreation of what you said.

These questions follow a phone conversation with Capt. Channell.

We would appreciate a reply as quickly as possible as the matter is of growing interest in our area and we need to get an accurate story across.

Sincerely,

Jimmie Bell

Jimmie Bell, Staff Writer
The Daily Herald
Box 4567, W. Biloxi Sta.
Biloxi, Miss. 39531

1-601-896-2312

JOHNSTON ISLAND SAMPLING PROTOCOL
AUGUST 1979

OBJECTIVE: To collect water, sediment and coral samples in selected locations at Johnston Island in support of the Herbicide Orange Site Monitoring Project.

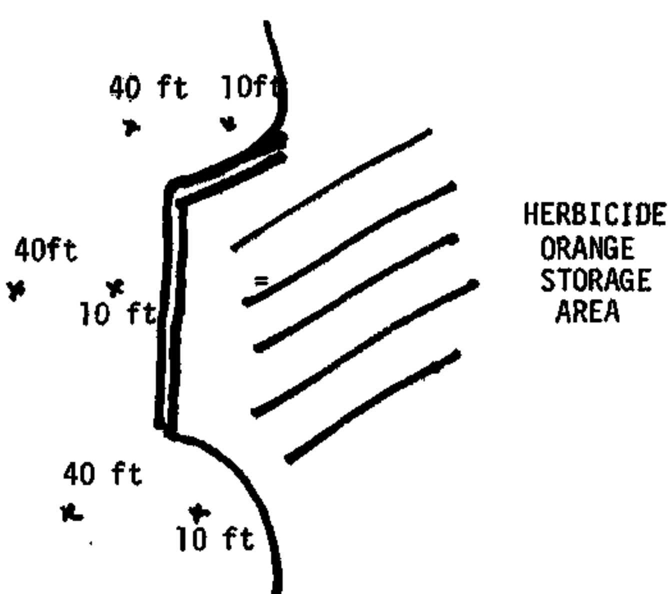
Total Number of Samples to be collected = 35

SAMPLE COMPOSITION AND PROTOCOL

Water: Five (5) 1 liter water samples should be collected at key sites on and around the Island. At least one sample should come from an area adjacent to the storage site. The location previously sampled by the Base Medical Staff should suffice. The samples should be collected in a 1 liter dark bottle with tight cap(aluminum insert). The bottle should be Number(by location), dated as follows:

JI-100 Water Sample
Location : Ten feet Off shore line
Near drainage pipe
adjacent HO Storage
Date: 7 Aug 1979
Johnston Island USAF OEHL/ECE

SEDIMENT: Two (2) sediment samples should be collected adjacent (off-shore) of Herbicide Storage area. The samples should represent at least three subsamples and should be approximately the top 8 cm (8 x 8 x 8cm) of sediment.



The three samples collected 10 feet from shore should be composited,dried, thoroughly mixed, crushed, and seived so as to pass through a #14 sieve. It should be subsampled into two 2 oz jars, appropriately labelled. One jar is to be sent to the FRC, University of Utah, and one jar to the USAF ACADEMY.

The three samples collected 40 feet from shore should be handled in the same manner.

Soil Cores: Two soil cores should be collected from selected sites on the Herbicide Storage area. The two sites selected are JI-10 and JI-37. Samples should be taken 15 cm from the Nail and Metal Label indicating site. Samples are to be collected in the following increments:

0 - 2 cm	8 - 12 cm
2 - 4 cm	12 - 16 cm
4 - 6 cm	16 - 20 cm
6 - 8 cm	20 - 24 cm

Each sample should be collected from an area of approximately 2 x 12 x 12 cm (D x L x W) and should be removed by sampling from the side of a ditch (See Figure 1). The ditch must be on the side away from the stake.

After carefully removing the increments, they should be dried, thoroughly crushed, and mixed. The sample should be sieved through a # 14 sieve. The sample should be subsampled into two 2 oz jars, appropriately labelled, and a sniff test conducted on it prior to sealing and preparation for shipment.

The sniff test should be conducted by at least two people in the following manner:

0 = no odor detectable

1 = Trace
2 = Mildly irritating
3 = Strong & irritating

The samples should be shipped to FRC & USAFA.

JI-10 Soil Sample
Depth: 0 - 2 cm
Date: 7 August 1979
Johnston Island
USAF OEHL/ECE

FIGURE 1. TECHNIQUE FOR OBTAINING SOIL INCREMENTS FOR PENETRATION STUDIES.

PHOTOGRAPHS OF ALL SITES AND AN OVERALL PHOTO OF THE AREA SHOULD BE TAKEN!!

SOIL SAMPLES: Twelve (12) samples should be obtained from areas where spills occurred. The selected sites are:

JI-5
JI-9
JI-12
JI-24
JI-26
JI-30
JI-34
JI-36
[redacted]
JI-39
JI-40
JI-41
JI-42

Each Sample should be collected 15 cm from the appropriate stake, and should be a 8 x 8 x 8 cm increment. It should not be in a depression which has been previously sampled. The old sampling sites are visible !

Each sample should be dried, crushed, mixed, sieved, evaluated with a sniff test, and subsampled into two 2 oz jars.

SHIPMENT OF SAMPLES:

The 5 water samples, one set of sediment samples (2), a set of the core samples (16), and a set of the soil samples (12) should be sent to:

FLAMMABILITY RESEARCH CENTER
ATTN: MR. W. H. McCLENNEN
UNIVERSITY OF UTAH
391 SOUTH CHIPETA WAY
P.O. Box 8089
SALT LAKE CITY, UTAH 84108

One set of sediment samples (2), a set of core samples (16), and s set of soil samples (12) should be sent to:

MAJOR WILLIAM J. CAIRNEY
USAFA/DFCBS-R
USAF ACADEMY COLORADO 80840

IF THE SAMPLES CAN BE SHIPPED IMMEDIATELY UPON ARRIVAL AT HICKHAM AFB, THEY NEED NOT BE REFRIGERATED. HOWEVER, THEY SHOULD (especially the water samples) be kept under refrigeration until shipment can be made. SHIP SAMPLES AIR EXPRESS. DO NOT FREEZE.

PROTOCOL DEVELOPMENT FOR ENVIRONMENTAL MONITORING OF STORAGE SITES PREVIOUSLY CONTAMINATED WITH ORANGE HERBICIDE

Following the at-sea incineration of surplus Herbicide Orange in the fall of 1977, an environmental monitoring study was developed for the former storage sites. Approximately 0.85 million gallons of this phenoxy herbicide had been stored for eight years on the Naval Construction Battalion Center (NCBC), Gulfport MS, with the remaining 1.37 million gallons stored for five years on Johnston Island, South Pacific. Although soils of both 12-acre storage sites were relatively homogenous, contamination due to drum leakage was heterogenous since neither the dates of spills nor the amount of herbicides or areas involved were recorded. The expected variability in the concentrations of herbicides, degradation products or other contaminants through-out the storage site dictated that a monitoring program: (a) provide inferences as to the range of residue levels in the soil for any area on the site, (b) be sufficiently replicated to be statistically valid, (c) be continued over a sufficiently long period of time for trends in residue degradation to be evidenced, and (d) be accomplished within budgetary limitations. In addition, the "ideal" monitoring program should have some method of determining a minimum level of residue that could be considered biologically and ecologically acceptable, i.e. a "no significant effect" residue level.

A preliminary study of soil penetration indicated that 95 percent of residues were within the top 8 cm of soil profile. Forty-two sampling sites were selected within each storage area on the basis of history, and discernible herbicide stain and odor. Three sets of soil samples, extending over a 20-month period have been collected and have been (or are being) analyzed for the esters and acids of 2,4-D and 2,4,5-T, di- and trichlorophenol and TCDD. The same samples have also been qualitatively and quantitatively analyzed for actino-myctes, fungi and bacteria.

HERBICIDE ORANGE SITE TREATMENT AND ENVIRONMENTAL MONITORING

REPORT AND RECOMMENDATIONS

FOR

FIELD COMMAND DEFENSE NUCLEAR AGENCY
JOHNSTON ISLAND, PACIFIC OCEAN

PREPARED FOR

AIR FORCE LOGISTICS COMMAND
WRIGHT -PATTERSON AFB OH

PROGRAMMING PLAN 75-19, ANNEX 8 FOR THE
DISPOSAL OF HERBICIDE ORANGE

UNITED STATES AIR FORCE
OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY
BROOKS AFB TX 78235

TECHNICAL REPORT OUTLINE

I. INTRODUCTION

LIST OF OBJECTIVES

II. PROTOCAL

SAMPLING SCHEME AND ANALYTICAL PROGRAM

III. RESULTS

A. MAGNITUDE OF CONTAMINATION

B. SOIL PERSISTENCE

C. FATE OF RESIDUE ON STORAGE SITE

D. FATE OF RESIDUE OFF STORAGE SITE

E. MICROBIAL DATA

IV. DISCUSSION OF DATA

A. CONCLUSIONS FROM DATA

B? PROPOSED MANAGEMENT TECHNIQUES FOR STORAGE SITES

C. RECOMMENDATIONS FOR USE OF SITE

VI RECOMMENDATION FOR FUTURE STUDIES

PHOTOGRAPHS OF THE SITE AND A MAP SHOULD BE INCLUDED

OBJECTIVES OF THE HERBICIDE ORANGE SITE MONITORING STUDY

1. To determine the magnitude of contamination of the storage site.
2. To determine the soil persistence of phenoxy herbicides, degradation products and TCDD.
3. To determine the fate of Herbicide Orange and TCDD in the storage area.
4. To monitor movement of residues from the site into water, sediments and biological organisms.
5. To determine the effects of residues on biological organisms.
6. To recommend managerial techniques for minimizing the impact of herbicides and TCDD residues on the ecology and human population adjacent or near the storage site.
7. To recommend options for use(s) of the storage area.

DATA SOURCE FOR MEETING OBJECTIVES:

Objective 1. University of Utah and USAF SAM/NGP (Sample analyses)

Objective 2. University of Utah and USAF SAM/NGP (Sample analyses)

Objective 3. University of Utah, USAF SAM/NGP, University of Hawaii, Washington State University (Soil Core and Laboratory Data)

Objective 4. University of Nebraska, University of Utah, Wright-State University and USAF OEHL/SA data

Objective 5. Department of Chemistry and Biological Sciences, USAF Academy

- The Objectives

- Description of Site & Historical review

- Previous studies

- Methods

- Results
  - TABLE of Summary values for Herbicide & TCDD
  - TABLE of Soil core # 17
  - TABLE of Biological Values
  - Figure showing Biological/sediment sampling

- Discussion

- Recommendations
  - Stabilized Ditch bank
  - Construct Cement

Data from Utah on
Herbicide levels on 4L 0/0 sites
TCDD levels in Sites
5, 10, 20, 22, 24, 37

Data from Nebraska

3 Oct 78

TCDD IN H/H SOILS

LOCATION	μg TCDD/gm Soil (ppm)
NCBC	
MEAN	0.152
RANGE	0.001 - 0.510
Median	0.130
JI	
Mean	0.046
Range	0.0002 - 0.230
Median	0.025

SAMPLES SENT [redacted] MASON HUGHES [redacted]
UNIVERSITY OF UTAH
[redacted] 19 JUN 79

DATA RECEIVED
1200 HR
22 JUN 79

Soil Core, Site #17, NCBC

Description	Actual Depth	Number Assigned to FRC	21 Jun 79 ppm	TCDD Conc. ppm
#17/1	0-2 cm	Oyster Shell	0.4	0.480
#17/2	2-4		0.5	0.510
#17/3	4-6	Gravel	0.1	0.150
#17/4	6-8		0.1	0.160
#17/5	8-12	Sandy Loam	0.15	0.300
#17/6	12-16	Soil	0.3	0.380
#17/7	16-20		ND<0.0001 ppm	0.0302
#17/8	20-24	Hardpan	–	0.0116
#17/9	24-39	Sand	Sample Contam.	0.00048
#17/10	39-55			0.00148
#17/11	55-70		ND<0.0001	0.00078

only one Mass Ion ↔ bottom 3 values being measured ↔ 50% variability

Two Mass Ions – in next 6 values 10-15% error at upper levels

WATER

DATE DATA RECEIVED
1000 HR
25 JUN 79

W-1	N.D	
W-2	N.D	at 25 ppt
BLANK	N.D	

Silts
1 ND < 2.0
S-2 3.6 ppb
3 ND < 2.00
4 ND < 2.0
5 NA < 2.0

S-6 < 37 ppb
S-7 < 20
S-8 2.8 ppb
S-9 ND. < 0.5 ppb
S-10 ND < 2.0 ppb
S-11 ND < 2.0

S-12 ND 0.5 ppb
S-13 ND 0.5 ppb

No. 336156

RECEIPT FOR CERTIFIED MAIL

SENT TO Dr. Mason Hughes	POSTMARK OR DATE
STREET AND NO.	
P.O., STATE AND ZIP CODE	

OPTIONAL SERVICES FOR ADDITIONAL FEES		CONSULT POSTMASTER FOR FEES
RETURN RECEIPT SERVICES	1. Shows to whom and date delivered	
	With restricted delivery	
	2. Shows to whom, date and where delivered	
	With restricted delivery	
RESTRICTED DELIVERY		
SPECIAL DELIVERY (extra fee required)		

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3. If you want a return receipt, write the certified-mail number and your name and address on a return receipt card, Form 3811, and attach it to the back of the article by means of the gummed ends. Endorse front of article RETURN RECEIPT REQUESTED.
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No. 336157

RECEIPT FOR CERTIFIED MAIL

SENT TO Dr. Michael Gross	POSTMARK OR DATE
STREET AND NO.	
P.O., STATE AND ZIP CODE	

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RETURN RECEIPT SERVICES	1. Shows to whom and date delivered	
	With restricted delivery	
	2. Shows to whom, date and where delivered	
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5. Save this receipt and present it if you make inquiry.

7 MAY 79

SPIKED SAMPLE

UTAH
AFLC, SOIL
SPIKED WITH
HERBICIDE
ORANGE
USAF OEHL
Brooks AFB, TX
7 MAY 79

Dr Mason Hughes
Flammability Research Center
391 South Chipeta Way
Post Office Box 8089
University of Utah
Salt Lake City, UT 84108
801-581-5843

Dr Michael Gross
Professor of Chemistry
Department of Chemistry
Hamilton Hall
University of Nebraska
Lincoln NE 68588
402-472-2794

DR HUGHES

27 Jul 79
1630 HR

NCBC Samples Collected 13-14 JUN 79

MAJ YOUNG

mg/g.

	DCP	TCP	D_{Acid}	T_{Acid}	D_{ester}	T_{ester}	
W-1	ND	.001	.008	.002	≤.007	≤.001	
Sediments							
S-1	ND	.1	1	1.1	ND	ND	
S-2	ND	.1	1	1.9	ND	<.03	
S-3	ND	.1	1	1.9	ND	0.4	
S-4	.1	.1	.3	0.5	.03	.1	
S-5	ND	.03	.5	.4	.07	.4	
S-6	.1	.05	.3	.3	.05	.02	
S-7	ND	.01	.2	.2	ND	.03	
S-8	ND	.06	.2	.5	ND	.04	
S-9	ND	ND	.2	.1	ND	ND	
S-10	ND	.01	.1	.03	ND	ND	
S-11	ND	.03	.1	.04	ND	ND	
S-12	ND	.02	.1	.02	ND	ND	
S-13	ND	.02	.2	[illegible]	ND	ND	
#17 [redacted] 1	ND	221	13,700	40,900	ND	67	.48
2	ND	92	7,500	8,800	ND	240	.16
3	ND	100	16,100	14,300	600	500	.30
4	ND	90	10,800	10,800	<1000	200	.15

5	170	750	54,800	55,300	215	4700	.51
6	.4	.6	32	42	.4	2	.00148
7	.4	.2	7	9	.2	.3	.00078
8	3	6	200	40	.1	.7	≤.00048
9	16	20	810	820	2	10	.0302
10	ND	48	14,100	12,400	ND	8	.38
11	15	20	480	395	<10	4	.0116

[illegible] ***
1[illegible] ***
[illegible].00 ***

4[illegible].00 ***
[illegible]86.00 ***
2.00 ***

5[illegible].00 ***
508.00 ***
3.00 ***

13[illegible].00 ***
[illegible]9.00 ***
4.00 ***

[illegible].00 ***
[illegible] ***
5.[illegible] ***

12[illegible].00 ***
27.00 ***
6.00 ***

[illegible].00 ***
[illegible].00 ***
7.00 ***

[illegible].00 ***
25[illegible].00 ***
5.00 ***

[illegible].00 ***
22.20 ***
9.00 ***

206 ± 117.9
161 ± 148.2

[illegible].00 ***
[illegible].70 ***
10.00 ***

$\bar{D}$ [illegible] ***
SD [illegible] ***
t [illegible].25 ***
df [illegible].00 ***

7 .95
1.8946
.90
1.415

328.00 ***
158.00 ***
1.00 ***

442.00 ***
180.00 ***
2.00 ***

510.00 ***
505.00 ***
3.00 ***

138.00 ***
115.00 ***
4.00 ***

21.00 ***
14.00 ***
5.00 ***

130.00 ***
29.00 ***
6.00 ***

240.00 ***
222.00 ***
7.00 ***

336.00 ***
251.00 ***
8.00 ***

$\bar{D}$ 60.25 ***
SD 91.4[illegible] ***
t 1.86 ***
df 7.00 ***

JI

15.00 ***
[illegible].00 ***
1.00 ***

29.00 ***
22.00 ***
2.00 ***

235.00 ***
220.00 ***
3.00 ***

11[illegible].00 ***
85.00 ***
4.00 ***

24.00 ***
29.00 ***
5.00 ***

2.00 ***
10.00 ***
6.00 ***

36.00 ***
32.00 ***
7.00 ***

152.00 ***
25.00 ***
8.00 ***

15.00 ***
15.00 ***
9.00 ***

94.00 ***
74.00 ***
10.00 ***

[illegible].00 ***
25.00 ***
11.00 ***

53.00 ***
95.00 ***
12.00 ***

12[illegible].00 ***
55.00 ***
13.00 ***

20.00 ***
25.00 ***
14.00 ***

$\bar{D}$ [illegible] ***
S [illegible] ***
t [illegible] ***
df 14.00 ***

	JAN 78	NOV 78	
SITE 1	0.328	0.198	
5	≤ 0.002	≤ .0387	?
10	0.042	.0242	?
16	0.442	0.198	
17	0.510	0.508	
19	0.130	0.119	
20	0.001	- .0037	?
22	≤ 0.002		
24	0.002	≥ .0128	?
26	0.011	0.014	
27	0.130	0.029	
30	0.240	0.222	
37	≤ 0.008	.0218	?
41	0.230	0.251	
	0.148		
	± 0.176		

5	.033	.019	.039
	.042	.029	.022
	.196	.235	.230
	.178	.111	.080
		.024	.025
		.003	.010
		.036	.038
		.152	.029
		.019	.015
		.094	.079
		.091	.029
		.053	.055
		.127	.085
		.020	.025

A	B
328	198
442	198
510	508
130	119
11	14
130	29
240	222
230	251

Kenneth J. Howard
Vertac Inc.
Box 69
Jacksonville
ARK
72076

10
9
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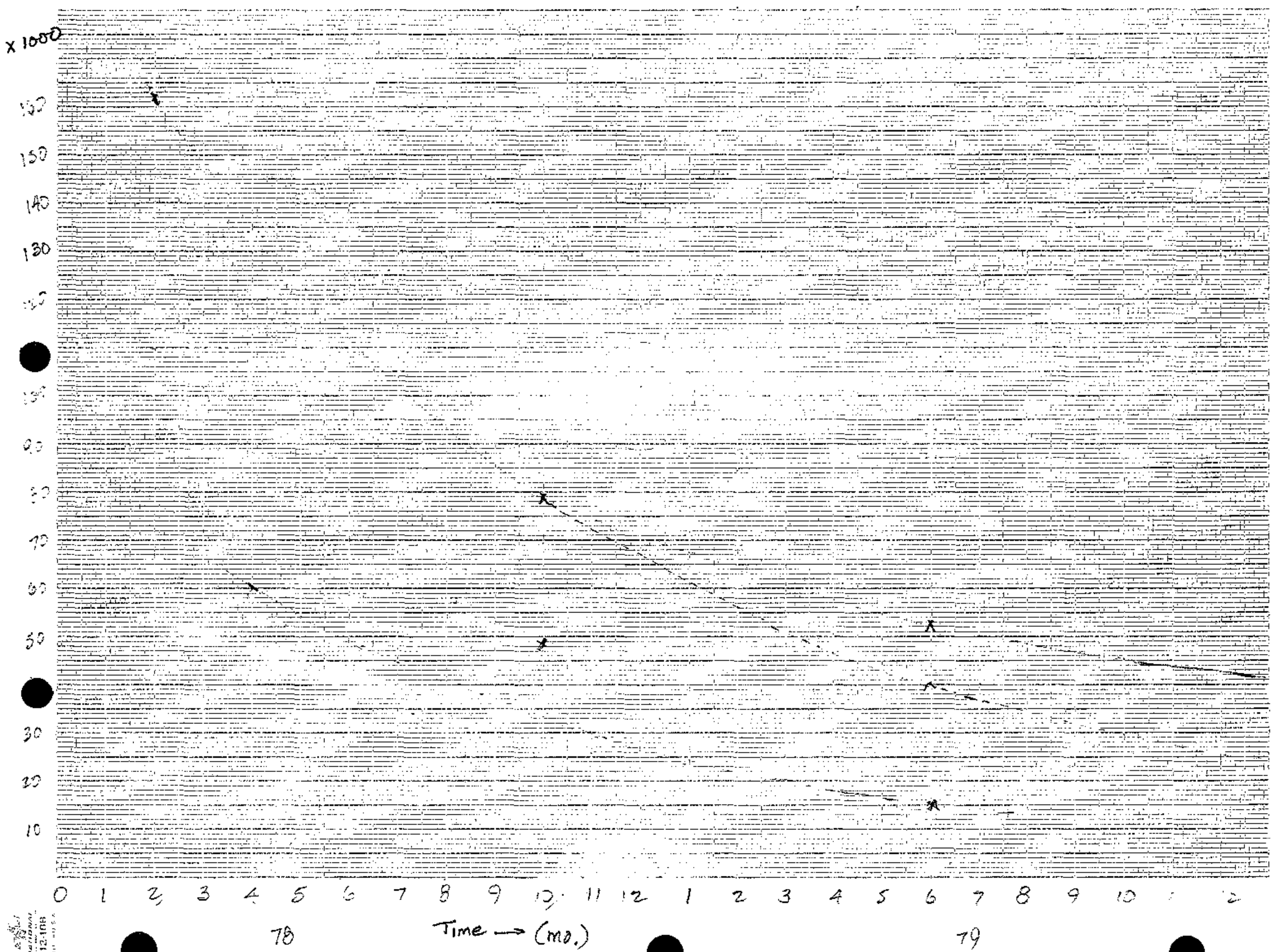
Semi-Logarithmic
3 Cycles x 10 to the inch


x 1000
150
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0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10
78
Time → (mo.)
79

JOHNSTON (ATOLL) ISLAND SAMPLES

Sample #	Type	Location	Amount	Date
JI-1/7879	Water	Composite of 3 locations adjacent to HO storage site 10' offshore and 3' below surface	1250 ml	7 AUG 79
JI-2/7879	Water	Intake of desalinization plant at orange buoy 5' below surface	1250 ml	7 AUG 79
JI-3/7879	Water	~200' offshore of North Island and 5' below surface	1250 ml	7 AUG 79
JI-4/7879	Water	Potable water from desalinization unit	1250 ml	7 AUG 79
JI-5/7879	Water	Dining hall (lavatory)	1250 ml	7 AUG 79
JI-6/7879	Sediment (ocean floor)	Composite of 3 locations adjacent to HO storage site 40' offshore	1250 ml	7 AUG 79
JI-7/7879	Sediment (ocean floor)	Composite of 3 locations adjacent to HO storage site 10' offshore	1250 ml	7 AUG 79
JI-8/8879	Coral	Site #5	8 cm cube (8x8x8)	8 AUG 79
JI-9/8879	"	" #9	"	"
JI-10/8879	"	" #12	"	"
JI-11/8879	"	" #24	"	"
JI-12/8879	"	" #26	"	"
JI-13/8879	"	" #30	"	"
JI-14/8879	"	" #34	"	"
JI-15/8879	"	" #36	"	"
JI-16/8879	"	" #39	"	"
JI-17/8879	"	" #40	"	"
JI-18/8879	"	" #41	"	"
JI-19/8879	"	" #42	"	"
			Incremental	
JI-20/8879	Coral	Site #10	0 - 2 cm	8 AUG 79
JI-21/8879	"	"	2 - 4 "	"
JI-22/8879	"	"	4 - 6 "	"
JI-23/8879	"	"	6 - 8 "	"
JI-24/8879	"	"	8 -12 "	"
JI-25/8879	"	"	12 -16 "	"
JI-26/8879	"	"	16 -20 "	"
JI-27/8879	"	"	20 -24 "	"
JI-28/8879	"	Site #37	0 - 2 "	8 AUG 79
JI-29/8879	"	"	2 - 4 "	"
JI-30/8879	"	"	4 - 6 "	"
JI-31/8879	"	"	6 - 8 "	"
JI-32/8879	"	"	8 -12 "	"
JI-33/8879	"	"	12 -16 "	"
JI-34/8879	"	"	16 -20 "	"
JI-35/8879	"	"	20 -24 "	"

SHIPPING CONTAINER TALLY 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

REQUISITION AND INVOICE/SHIPPING DOCUMENT

SHEET NO.	NO. OF SHEETS	5. REQUISITION DATE	6. REQUISITION NO.
1	1	14 Aug 1979	F823157922 6 X 026

1. FROM
USAF OEHL/ECE BROOKS AFB, TEXAS 78235

7. DATE MATERIEL REQUIRED 15 Aug 1979

8. PRIORITY 03

2. TO
Major William J. Cairney, USAFA [illegible] DFCBS-R
Fairchild Hall RM 2A29, Bldg 2354
USAF Academy, Co. 80840

9. AUTHORITY OR PURPOSE
Samples for analysis

10. SIGNATURE (signature)

11a. VOUCHER NUMBER AND DATE

3. SHIP TO - MARK FOR
MAJOR WILLIAM J. CAIRNEY
USAF ACADEMY COLORADO 80840 Tele:(303) 472-2720

12. DATE SHIPPED

b. VOUCHER NUMBER AND DATE

13. MODE OF SHIPMENT
Air

14. BILL OF LADING NUMBER

15. AIR MOVEMENT DESIGNATOR OR PORT REFERENCE NUMBER

4. ACCOUNTING AND FUNDING DATA
5793400-309-47BQ-125660-B8-463S528500 GDelaVega

ITEM NO. a	FEDERAL STOCK NUMBER, DESCRIPTION, AND CODING OF MATERIEL AND/OR SERVICES b	UNIT OF ISSUE c	QUANTITY REQUESTED d	SUPPLY ACTION e	TYPE CONTAINER f	CONTAINER NOS. g	UNIT PRICE h	TOTAL COST i
	SPECIMENS FOR LABORATORY ANALYSIS	BX	1					
	Pre Pack (DO NOT FREEZE)							

16. TRANSPORTATION VIA MATS OR MSTS CHARGEABLE TO

17. SPECIAL HANDLING

18. RECAPITULATION OF SHIPMENT	TOTAL CONTAINERS	TYPE CONTAINER	DESCRIPTION	TOTAL WEIGHT	TOTAL CUBE
ISSUED BY					
CHECKED BY PHEQ 817221					
PACKED BY					
			TOTAL		

19. RECEIPT	DATE	BY	
CONTAINERS RECEIVED EXCEPT AS NOTED			SHEET TOTAL
QUANTITIES RECEIVED EXCEPT AS NOTED			GRAND TOTAL
POSTED			20. RECEIVER'S VOUCHER NO.

SHIPPING CONTAINER TALLY 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

REQUISITION AND INVOICE/SHIPPING DOCUMENT

SHEET NO. 1	NO. OF SHEETS 1
5. REQUISITION DATE	14 Aug 1979
6. REQUISITION NO.	782857 922 exo4
1. FROM	USAF OEHL/ ECE BROOKS AFB, TEXAS 78235
7. DATE MATERIEL REQUIRED	15 Aug 1979
8. PRIORITY	03
2. TO	Mr. W. H. McClennen, Flammability Research Center 391 South Chipeta Way P.O. Box 8098 University of Utah, Salt Lake City, UT 84108
9. AUTHORITY OR PURPOSE	Samples for analysis
10. SIGNATURE	[signature]
11a. VOUCHER NUMBER AND DATE	
3. SHIP TO - MARK FOR	Mr. W. H. McClennen Flammability Research Center Tele: (801) 581-8431 HOLD FOR PICKUP
12. DATE SHIPPED	
b. VOUCHER NUMBER AND DATE	
13. MODE OF SHIPMENT	AIR EXPRESS
14. BILL OF LADING NUMBER	
15. AIR MOVEMENT DESIGNATOR OR PORT REFERENCE NUMBER	
4. ACCOUNTING AND FUNDING DATA	5793400-309-47BQ-125660-B8-463S528500 C DelaVega

ITEM NO. a	FEDERAL STOCK NUMBER, DESCRIPTION, AND CODING OF MATERIEL AND/OR SERVICES b	UNIT OF ISSUE c	QUANTITY REQUESTED d	SUPPLY ACTION e	TYPE CON-TAINER f	CON-TAINER NOS. g	UNIT PRICE h	TOTAL COST i
	SPECIMENS FOR LABORATORY ANALYSIS (DO NOT FREEZE) Pre Pack JI & GP.	BX	3					

16. TRANSPORTATION VIA MATS OR MSTS CHARGEABLE TO

17. SPECIAL HANDLING

18. RECAPITULATION OF SHIPMENT	TOTAL CONTAINERS	TYPE CONTAINER	DESCRIPTION	TOTAL WEIGHT	TOTAL CUBE
ISSUED BY					
CHECKED BY PHEW 922					
PACKED BY			TOTAL		

19. RECEIPT	DATE	BY	
CONTAINERS RECEIVED EXCEPT AS NOTED			SHEET TOTAL
QUANTITIES RECEIVED EXCEPT AS NOTED			GRAND TOTAL
POSTED			20. RECEIVER'S VOUCHER NO.

DD FORM 1 MAR 59 1149 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

REPLACES EDITION OF 1 MAY 58 WHICH MAY BE USED

18 JUL 1979

Mr Ed Bramlitt — Needs one more copy of J.I. Report From Battelle

Field Command DNA

FCDNA / FCLS

Kirtland AFB NM 87115

AV 964-9566 or 9186

Lt. Col. Sfameni Commander Johnston Atoll // FCJ //

AV 315-441-3005

Major Steve Phillippi Engineer

Air Micronesia	M, W, Th, S	0730 → 0918	Hono → JI
	T F	2330 → 0113	JI → Hono

DEPARTMENT OF THE AIR FORCE
USAF OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY (AFSC)
BROOKS AIR FORCE BASE, TEXAS 78235

REPLY TO ATTN OF: ECE

SUBJECT: Request Support for Johnston Atoll TDY

18 JUL 1979

TO: SU/Mr Buffin

1. Request your assistance in preparing and coordinating the required documentation for a USAF OEHL/CC directed TDY to Johnston Atoll.

a. A message requesting threater clearance is attached.

b. The short notice explanation is included in the message.

c. TDY orders request is attached.

d. To meet required sampling procedure and have island personnel available to support the sampling program, travel needs to take place as follows:

7 Aug 79	-	San Antonio to Honolulu	
8 Aug 79	-	Air Micronesia	0730-0918 hrs to JA
10 Aug 79	-	Air Micronesia	2330-0113 hrs to Honolulu

It may be possible to take the MAC flight back to Honolulu at about 1300 hours on Friday, saving that portion of the airfare.

e. Since Air Micronesia flights leave Honolulu at 0730 hours on Monday, Wednesday, Thursday, and Saturday and return at 2330 hours on Tuesday and Friday, it is necessary to travel to Honolulu the day before departure to Johnston Atoll.

2. Telephone coordination with Field Command, Defense Nuclear Agency and Johnston Atoll Commander will be accomplished today.

CHARLES E. THALKEN, LtCol, USAF, VC
Chief, Environmental Assessment Branch

2 Atch
1. Msg, USAF OEHL/ECE
2. TDY Orders Request

JOINT MESSAGEFORM

SECURITY CLASSIFICATION: UNCLASSIFIED

PAGE	DRAFTER OR RELEASER TIME	PRECEDENCE ACT	PRECEDENCE INFO	LMF	CLASS	CIC	FOR MESSAGE CENTER/COMMUNICATIONS CENTER ONLY	DATE - TIME	MONTH	YR
01 OF 02		RR	RR		UUUU			Z	JUL	79

BOOK: NO

MESSAGE HANDLING INSTRUCTIONS

FROM: USAF OEHL BROOKS AFB TX//ECE//

TO: CMDR JOHNSTON ATOLL//FCJ//

INFO: FCDNA KIRTLAND AFB NM//CC//

UNCLAS

SUBJ: REQUEST FOR THEATER CLEARANCES

1. REQUEST ENTRY AUTHORIZATION FOR THE FOLLOWING USAF OEHL/ECE PERSONNEL LISTED BY RANK, NAME, AFSN, SECURITY CLEARANCE, DATE OF CLEARANCE AND CITIZENSHIP: A. LTCOL CHARLES E. THALKEN, 505-54-7466, SECRET, NAC AUG 1964, US. B. CAPTAIN ROBERT J. SARVAIDEO, 075-38-0549FV, SECRET, NAC MAR 1979, US.

2. OFFICERS PLAN TO ARRIVE JA 8 AUG 79 AND TO DEPART 10 AUG 79. PURPOSE OF TRIP IS TO COLLECT ADDITIONAL CORAL SAMPLES FROM HO STORAGE SITE AND WATER SAMPLES FROM ADJACENT AREAS IN SUPPORT OF SITE RECLAMATION/MONITORING PROGRAM.

3. SUPPORT REQUIRED INCLUDES SURVEYING TEAM FROM CE TO LOCATE FORTY-TWO PREVIOUS TEST HOLES ESTABLISHED 25 AUG 77 AND 9 JAN 78.

4. SHORT NOTICE APPROVAL IS REQUESTED DUE TO RECENT CONTRACT CHANGES WITH SUPPORT LABORATORY REQUIRING EARLIER SUBMISSION OF SAMPLES THAN

DISTR:

CY TO: CV

DRAFTER TYPED NAME, TITLE, OFFICE SYMBOL, PHONE & DATE:
CHARLES E. THALKEN, CH ENVIRON ASSESS BR
ECE, 3667, 18 JUL 79

SPECIAL INSTRUCTIONS

RELEASER TYPED NAME, TITLE, OFFICE SYMBOL AND PHONE:
J.E.BUFFIN, CH ADM & DOC BR, 3421

SIGNATURE

SECURITY CLASSIFICATION: UNCLASSIFIED

DD FORM 1 DEC 70 173 — REPLACES PREVIOUS EDITION WHICH WILL BE USED. ☆GPO 1972-469-252

JOINT MESSAGE FORM

SECURITY CLASSIFICATION: UNCLASSIFIED

PAGE	DRAFTER OR RELEASER TIME	PRECEDENCE ACT	PRECEDENCE INFO	LMF	CLASS	CIC	FOR MESSAGE CENTER/COMMUNICATIONS CENTER ONLY	DATE - TIME	MONTH	YR
01 OF 02		RR	RR		UUUU			Z	JUL	79

BOOK	MESSAGE HANDLING INSTRUCTIONS
NO	

FROM:

TO:

ORIGINALLY PLANNED SO THAT ALL PHASES OF THE CONTRACT ARE TO BE COMPLETED 1 OCT 1979.

DISTR:

CY TO: CV

DRAFTER TYPED NAME, TITLE, OFFICE SYMBOL, PHONE & DATE

CHARLES E. THALKEN, CH ENVIRON ASSESS BR
ECE, 3667, 18 JUL 79

SPECIAL INSTRUCTIONS

RELEASER

TYPED NAME, TITLE, OFFICE SYMBOL AND PHONE

J.E.BUFFIN, CH ADM & DOC BR, 3421

SIGNATURE

SECURITY CLASSIFICATION

Capt Young AEY File! ECE Oct 20/78

B64-①

TOR-262194 5Z ROUTINE

MLN-002270

RAAUZYUW RUWTRFA0255 2621830-UUUU--RUVKAAB.
ZNR UUUUU
R 191650Z SEP 78
FM HQ USAF ACADEMY CO/DFCBS
TO RUHHJIA/CMDR JOHNSTON ATOLL /FCJX
INFO RUEAHQA/HQ WASH DC/SGP
RUVAAAA/HQ AFLC WPAFB OH/LOS
RUEBDBA/HQ DNA WASH DC/DALG
RUWTFBF/FCDNA KIRTLAND AFB NM/FCLG
RUVKAAB/USAF OEHL BROOKS AFB TX/CC
BT
UNCLAS

OEHL/CC 2R

SUBJ: REQUEST FOR THEATER CLEARANCES
1. REQUEST ENTRY AUTHORIZATION FOR THE FOLLOWING USAF ACADEMY PERSONNEL LISTED BY RANK, NAME, AFSN, SECURITY CLEARANCE, DATE OF CLEARANCE AND CITIZENSHIP.
A. MAJ WILLIAM J. CAIRNEY, 153-34-3903FR, SECRET, APR 64, US.
B. 2ND LT JEFFREY E. FELLMETH, 136-42-3930, SECRET, FEB 74, US.
2. OFFICERS PLAN TO ARRIVE JA 17 OCT 78 AND DEPART 21 OCT 78. PURPOSE OF TRIP IS TO COLLECT ADDITIONAL CORAL SAMPLES FROM HO STORAGE SITE IN SUPPORT OF SITE RECLAMATION/MONITORING PROGRAM.

3. SUPPORT REQUIRED INCLUDES SURVEYING TEAM FROM CE TO LOCATE 42 PREVIOUS TEST HOLES ESTABLISHED 25 AUG 77 AND 9 JAN 78.
BT
#0255

NNNN

USAF OEHL	Action	Coord	Info	File
CC			✓	OK
CV ✓			✓	OK
OE				
SU				
TS				
EC	✓ OK			
SA				

TOR-262194 5Z ROUTINE

MLN-002270

201 file JK 5A

1 1 RR RR UUUU 161850Z FEB 78

USAF OEHL BROOKS AFB TX/EC

COMMANDER JOHNSTON ATOLL/FCJ

INFO: FCDNA KIRTLAND AFB NM/FCL

UNCLAS

SUBJ: HERBICIDE ORANGE DISPOSAL PROGRAM YOUR MSG 142325Z FEB 78.

1. REFERENCE IS MADE TO ITEMS DISCUSSED DURING CAPT YOUNG'S TDY IN JAN 78. ITEM 2A, YOUR MSG, THE FREQUENCY OF WATER SAMPLING AND MODIFICATION OF THE WATER SAMPLING PROGRAM WERE CONTAINED IN USAF OEHL/CC LTR DTD 3 FEB 78. ITEM 2B, YOUR MSG, PURPOSES OF EXCLUDING VEHICULAR TRAFFIC OVER OR ON THE FORMER STORAGE SITE IS TO REDUCE UNNECESSARY SPREADING OF KNOWN CONTAMINATION FROM THE SITE, PRECLUDING ANALYTICAL INTERFERENCES IN SAMPLES COLLECTED DURING THE MONITORING PROGRAM.

2. AS DISCUSSED WITH JOHNSTON ISLAND STAFF DURING JAN TDY, TEMPORARY BARRICADES FOR EXCLUDING TRAFFIC WILL BE SUFFICIENT. ESTIMATE MAXIMUM EXCLUSION APPROXIMATELY 18 MONTHS.

JAMES R. TREMBLAY, Major, USAF, BSC
Acting Chief, Consultants Division/EC
X2891, 15 Feb 78 lmp

CURTIS/MICHAEL, SU, 3422
ADMIN ASST

UNCLASSIFIED

Capt Young ACY   ECE cat 20 9/78

File!

B64-①

TOR-2621945Z

ROUTINE

MLN-002270

RAAUZYUW RUWTRFA0255 2621830-UUUU--RUVKAAB.
ZNR UUUUU
R 191650Z SEP 78
FM HQ USAF ACADEMY CO/DFCBS
TO RUHHJIA/CHOR JOHNSTON ATOLL/FCJX
INFO RUEAHQA/HQ WASH DC/SGP
RUVAAAA/HQ AFLC WPAFB OH/LOS
RUEBDBA/HQ DNA WASH DC/DALG
RUWTFDF/FCDNA KIRTLAND AFB NM/FCLG
RUVKAAB/USAF OEHL BROOKS AFB TX/CC
BT

OEHL/CC

UNCLAS
SUBJ: REQUEST FOR THEATER CLEARANCES
1. REQUEST ENTRY AUTHORIZATION FOR THE FOLLOWING USAF ACADEMY PERSONNEL LISTED BY RANK, NAME, AFSN, SECURITY CLEARANCE, DATE OF CLEARANCE AND CITIZENSHIP.
A. MAJ WILLIAM J. CAIRNEY, 153-34-3903FR, SECRET, APR 64, US.
B. 2ND LT JEFFREY E. FELLMETH, 136-42-3930, SECRET, FEB 74, US.
2. OFFICERS PLAN TO ARRIVE JA 17 OCT 78 AND DEPART 21 OCT 78. PURPOSE OF TRIP IS TO COLLECT ADDITIONAL CORAL SAMPLES FROM HO STORAGE SITE IN SUPPORT OF SITE RECLAMATION/MONITORING PROGRAM.

3. SUPPORT REQUIRED INCLUDES SURVEYING TEAM FROM CE TO LOCATE 42 PREVIOUS TEST HOLES ESTABLISHED 25 AUG 77 AND 9 JAN 78.
BT
#0255

NNNN

USAF OEHL	Action	Coord	Info	File
CC			✓	OK
CV ✓			✓	OK
QE				
SU				
TS				
EC	✓	OK		
SA				

TOR-2621945Z

ROUTINE

MLN-002270

JOINT MESSAGEFORM | SECURITY CLASSIFICATION: UNCLASSIFIED

PAGE	DRAFTER OR RELEASER TIME	PRECEDENCE ACT	PRECEDENCE INFO	LMF	CLASS	CIC	FOR MESSAGE CENTER/COMMUNICATIONS CENTER ONLY	DATE - TIME	MONTH	YR
01 OF 02		PP	RR		UUUU			211645Z	DEC	77

BOOK | MESSAGE HANDLING INSTRUCTIONS

FROM: USAF OEHL BROOKS AFB TX/CC

TO: CMDR JOHNSTON ATOLL/FCJN

INFO: HQ USAF WASH DC/SGP

HQ AFLC WPAFB OH/LOS

HQ DNA WASH DC/DALG

FCDNA KIRTLAND AFB NM/FCLG

USAF ACADEMY CO/DFCBS-R

UNCLAS

SUBJ: REQUEST FOR THEATER CLEARANCES

1. THIS MSG COORDINATED WITH HQ AFLC/LOS VIA TELECON 21 DEC 77.

2. REQUEST ENTRY AUTHORIZATION FOR THE FOLLOWING USAF OEHL AND USAF ACADEMY PERSONNEL LISTED BY RANK, NAME, AFSN, SECURITY CLEARANCE, DATE OF CLEARANCE, AND CITIZENSHIP.

A. CPT ALVIN L. YOUNG, 520-44-1612FR, SECRET, FEB 69, US.

MAJ 34-3903

B. ~~CPT~~ WILLIAM J. CAIRNEY, 153-44-1612FR, SECRET, APR 64, US.

3. OFFICERS PLAN TO ARRIVE JA 9 JAN 78 AND DEPART 12 JAN 78. PURPOSE OF TRIP IS TO CONDUCT VEGETATIVE SURVEY AND COLLECT ADDITIONAL CORAL SAMPLES FROM HO STORAGE SITE IN SUPPORT OF THE SITE

DISTR:

DRAFTER TYPED NAME, TITLE, OFFICE SYMBOL, PHONE & DATE

SPECIAL INSTRUCTIONS

RELEASER TYPED NAME, TITLE, OFFICE SYMBOL AND PHONE: JOHN E. BUFFIN/ADM MGR/SU/X3422

SIGNATURE: J Buffin

SECURITY CLASSIFICATION: UNCLASSIFIED

JOINT MESSAGE FORM

SECURITY CLASSIFICATION: UNCLASSIFIED

PAGE	DRAFTER OR RELEASER TIME	PRECEDENCE ACT	PRECEDENCE INFO	LMF	CLASS	CIC	FOR MESSAGE CENTER/COMMUNICATIONS CENTER ONLY	DATE - TIME	MONTH	YR
02 OF 02		PP	RR		UUUU			211645Z	DEC	77

BOOK

MESSAGE HANDLING INSTRUCTIONS

FROM:

TO:

RECLAMATION/MONITORING PROGRAM.

4. SUPPORT REQUIRED INCLUDES A SURVEYING TEAM FROM CE TO LOCATE 12 (TWELVE) PREVIOUS TEST HOLES (HO PROJECT, 25 AUG 77) AND ESTABLISH/ MAP 30 (THIRTY) ADDITIONAL SITES AT THE HO STORAGE SITE.

DISTR:

DRAFTER TYPED NAME, TITLE, OFFICE SYMBOL, PHONE & DATE

SPECIAL INSTRUCTIONS

RELEASER

TYPED NAME, TITLE, OFFICE SYMBOL AND PHONE

SIGNATURE

SECURITY CLASSIFICATION: UNCLASSIFIED

Capt Young   O AAOEHL

TOR-3052052Z   ******************************   ROUTINE
* UNCLASSIFIED E F T O   1 NOV 77 21
MLN-003131   ******************************

RTTEZYUW RUHHJIA0011 3052028-EEEE--RUVKAAA.
ZNY EEEEE
R 011815Z NOV 77
FM COMMANDER JOHNSTON ATOLL/FCJ
TO RUVKAAA/ZOL AA USAF OEHL KELLY AFB TX/CC
INFO RUWTFBF/FCDNA KIRTLAND AFB NM/FCSS
BT
UNCLAS E F T O
SUBJ: ENTRY AUTHORIZATION. REF YOUR MSG P 311400Z OCT 77 FOR CPT ALVIN L. YOUNG AND CPT WILLIAM J. CAIRNEY
1. ENTRY APPROVED AS REQUESTED.
2. ONE COPY OF TRAVEL ORDERS IS REQUIRED FOR IN-PROCESSING AT JOHNSTON ATOLL TERMINAL.
3. THE CHARGE FOR SUBSISTENCE AND QUARTERS FOR ALL TDY PERSONNEL IS $12.00 PER DAY.
4. AIR MIC WILL BE ADVISED OF ISLAND CLEARANCE.
BT
#0011

NNNN

USAF ENVIRONMENTAL HEALTH LABORATORY
1 NOV 77 20 8 33
RECEIVED

TOR-3052052Z   ******************************   ROUTINE
* UNCLASSIFIED E F T O *
MLN-003131   ******************************

STATUS OF SOIL SAMPLES SUBMITTED TO FRC

29 Mar 79

FY 79 Contract to University of Utah

SITE LOCATION	Date Samples Collected	Date Samples Evaluated for Oder Rating	Dates Samples Shipped to FRC	Number of Samples
Johnston Island	17 Oct 78	15 Feb 79	30 Oct 78	42
NCBC	6 Nov 78	21 Nov 78	22 Nov 78	44
Johnston Island	25 Aug 77	29 Mar 79	29 Mar 79	12
NCBC	28 Jul 77	29 Mar 79	29 Mar 79	11
		Total Number of Samples for Routine Analysis		109

Samples sent for GC/MS Component Study

Hill Sample # 21 Collect Nov 78

NCBC Sample # GP 24 Collected Jan 78

JI Sample # JI 6 Collected Jan 78

29 MAR 1979

GC/MS

Alvin L Young

ALVIN L. YOUNG, Major, USAF
Consultant, Environmental Sciences

USAF OEHL/ECE
BROOKS AFB TX 78235

-1, 1 JOHNSTON ISLAND
25 AUGUST 77

-1, 2 JOHNSTON ISLAND
25 Aug 77

-1, 3 JOHNSTON ISLAND
25 Aug 77

-1, 4 JOHNSTON ISLAND
25 Aug 77

-1, 5 Johnston Island
25 Aug 77

-1, 6 Johnston Island
25 Aug 77

-1, 7 Johnston Island
25 Aug 77

-1, 8 Johnston Island
25 Aug

-1, 9 Johnston Island
25 Aug 77

-1, 10 Johnston Island
25 Aug 77

-1, 11 Johnston Island
25 Aug 77

-1, 12 Johnston Island
25 Aug 77

SU 4 October 1978

Request For Travel Outside CONUS, RE: Capt Alvin L. Young

AMD/DAAO

1. The requirement to travel to Johnston Atoll by Captain Alvin L. Young effective on/about 15 Oct 78 has been cancelled.

2. Arrangements have been made with personnel assigned to the USAF Academy, who have been successful in obtaining a theater clearance, to conduct the survey and make necessary coral sample collections.

3. Request all action to obtain a theater clearance be terminated.

SIGNED

JOHN E. BUFFIN
Chief, Administration & Documentation Branch

Cy to: EC

26 Aug 77

Major Bill Cairney
USAFA/DFCBS-R
USAF Academy CO 80840

Dear Bill,

Enclosed are 15 coral samples from the storage site and area here at J.I., marked:

Sample	#1	-	Control Sample	-	0"-6"	Coral Sample	0/0*
"	#2	-	Site Sample	-	0"-6"	Coral Sample	0/0
"	#3	-	" "	-	0"-6"	" "	0/0
"	#4	-	" "	-	0"-6"	" "	0/0
"	#5	-	" "	-	0"-6"	" "	L/L**
"	#6	-	" "	-	0"-6"	" "	L/L
"	#7	-	" "	-	0"-6"	" "	L/L
"	#8	-	" "	-	0"-6"	" "	L/L
"	#9	-	" "	-	0"-6"	" "	H/H***
"	#9A	-	" "	-	6"-12"	" "	H/H
"	#9B	-	" "	-	12"-24"	" "	H/H
"	#9C	-	" "	-	18"-24"	" "	H/H
"	#9D	-	" "	-	0"-6"	" "	H/H
"	#10	-	" "	-	0"-6"	" "	H/H
"	#11	-	" "	-	0"-6"	" "	H/H
"	#12	-	" "	-	0"-6"	" "	H/H

* - From site with no visable signs of spill and no H.O. odor

** From site with some light H.O., stain and slight odor of H.O.

*** - From site with heavy H.O., stain and strong odor of H.O.

Please run all of these samples for soil microrganisms.

Charles E. Thalken

Charles E. Thalken, Major USAF VC
Project Pacer HO,
Consultant Enviromentalist

DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFSC)
BROOKS AIR FORCE BASE, TEXAS 78235

REPLY TO ATTN OF: NGP

28 January 1977

SUBJECT: Report of Herbicide Analysis

TO: USAFOEHL (Maj Tremblay)
Kelly AFB TX 78241

1. Six samples from Johnson Island were analyzed for the presence of the herbicides, 2, 4-D and 2, 4, 5-T free acid forms and 2, 4, D and 2, 4, 5-T n-butyl ester forms. Samples were analyzed by both flame ionization and electron capture gas-liquid chromatography. All four herbicide forms were determined in one set of samples using the method of Arnold and Young, FUSRL(NC) TM, 76-5, Dec 76. A second set of samples were analyzed for total 2, 4-D and 2, 4, 5-T using a modification of this method involving electron capture detection for increased sensitivity. Results of the analysis are given in tabular form below.

FID Analysis *in ppm*

	Sample #	2,4,D			2,4,5-T			Total
		Acid	Ester	Total	Acid	Ester	Total	Herbicide
0-6" Control	JI6274 SE 1	<20	<20	<20	<20	<20	<20	<20
6-12" Control	JI6274 SE 2	<20	<20	<20	<20	<20	<20	<20
0-6"	JI6274 SO 1	<20	<20	<20	<65	<20	65	65
6-12"	JI6274 SO 2	<20	<20	<20	<20	<20	<20	<20
0-6"	JI6274 SO 3	220 ± 60	340 ± 10	560	<20	710 ± 45	710	1270
6-12"	JI6274 SO 4	<20	135 ± 27	135	240 ± 60	340 ± 83	580	715

EC Analysis *in ppm*

	Sample #	2,4,D Acid	2,4,D Ester	2,4,D Total	2,4,5-T Acid	2,4,5-T Ester	2,4,5-T Total	Total Herbicide
0-6" Control	JI6274 SE 1	-	-	<1	-	-	<2	<2
6-12" Control	JI6274 SE 2	-	-	<1	-	-	<1	<1
0-6"	JI6274 SO 1	-	-	<1	-	-	<1	<1
6-12"	JI6274 SO 2	-	-	<1	-	-	<2	<2
0-6"	JI6274 SO 3	-	-	475 ± 30	-	-	700 ± 45	1175
6-12"	JI6274 SO 4	-	-	110 ± 10	-	-	680 ± 55	790

EUGENE L. ARNOLD, Lt Col, USAF, BSC
Chief, Analytic Chemistry Function
Clinical Pathology Branch

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE PROGRAMS
FEDERAL CENTER BUILDING
HYATTSVILLE, MARYLAND 20782

IX
(1)

October 18, 1976

Colonel Walter W. Melvin, Jr.
United States Air Force Environmental
Health Laboratory
Kelly Air Force Base, TX 78241

Dear Colonel Melvin:

In response to your recent request, we have issued Permit No. S-1805 for the importation of untreated soil samples. Please note from the permit itself the safeguards which must be followed when importing such material.

The permit has been made valid through Oct. 31, 1978 and may be revalidated upon receipt of a written request. We are enclosing 50 PPQ Form 550 labels. One of these labels should be attached to the outside of each container of soil as evidence that entry has been authorized. Only one label is required for each container of soil regardless of the number of samples contained therein. Additional labels will be supplied upon receipt of a written request.

Soil samples offered for entry without a valid PPQ Form 550 label attached will be held at the port of arrival until the existence of a valid permit has been determined.

Sincerely,

Jack E. Lipes

Jack E. Lipes
Head, Permit Unit
National Program Planning Staff

Enclosures

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE PROGRAMS
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Jack E. Lipes

Jack E. Lipes
Head, Permit Unit
National Program Planning Staff

Enclosures

NCR PAPER – NO CARBON REQUIRED

U. S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE PROGRAMS

APPLICATION FOR PERMIT TO MOVE SOIL

INSTRUCTIONS: Applicant please complete Items 1 thru 21. Use reverse for continuation or additional remarks.

DO NOT USE: S-1805

FORWARD THIS APPLICATION TO:
U. S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine Programs
Federal Building
Hyattsville, Maryland 20782

1. NAME AND ADDRESS OF APPLICANT *(Include Zip Code)*
United States Air Force Environmental
Health Laboratory
Kelly Air Force Base, Texas 78241
Attn: Colonel Walter W. Melvin, Jr.

	2. TYPE OF SOIL	3. COUNTRY OF ORIGIN	4. DEPTH TAKEN FROM SURFACE	5. NUMBER OF SAMPLES	6. APPROX. WEIGHT OF EACH
A.	Coral Soil	Johnston Atoll, USA	0-2 ft.	100	2 lb.
B.	Beach Sediment	Johnston Atoll, USA	0-2 ft.	100	2 lb.
C.					
D.					

7. WILL HEAT STERILIZATION OF SOIL *(before its release to you)* **INTERFERE WITH ITS INTENDED USE?**
☐ NO *(If NO, check preferred treatment)* ☐ Dry Heat ☐ Steam Heat
☒ YES *(If YES, item 19 must be signed by the Head of the Laboratory receiving the soil.)*

8. NUMBER OF SHIPPING CONTAINERS: 50

9. METHOD OF PACKAGING SOIL: Sturdy, leakproof containers within a shipping container.

10. METHOD OF SHIPMENT: ☒ Mail ☐ Cargo ☐ Baggage

11. SHIPPED BY: ☒ Air ☐ Surface

12. PORT OF ARRIVAL: Honolulu, HI

13. DATE OF ARRIVAL: Approx Oct. 31, 1976

14. DESTINATION WHERE SOIL WILL BE USED *(City and State)***:** San Antonio, Texas

15. ARE OTHER IMPORTATIONS CONTEMPLATED WITHIN THE NEXT TWO YEARS? ☒ Yes ☐ No

16. IS SOIL TO BE USED AS GROWING MEDIUM? ☐ Yes ☒ No *if NO, state intended use* Analyses for herbicide components.

17. PRECAUTIONS TO BE USED TO PREVENT PLANT PEST DISSEMINATION Samples to be used only for analytical purposes. Purified extracts may be sent to other labs for analyses, but original sample will be processed only by permittee.

18. METHOD OF FINAL DISPOSITION *(Autoclaving, incineration, or other)* Unconsumed samples and containers will be sterilized by permittee at Kelly Air Force Base, Texas.

19. SIGNATURE OF APPLICANT OR AGENT *(Laboratory Head must sign if you checked YES in item 7.)*
/s/ Walter W. Melvin, Jr., Colonel USAF, MC
Commander

20. TELEPHONE NUMBER:

21. DATE: September 30, 1976

TO BE COMPLETED BY STATE REGULATORY OFFICIAL

COMMENTS

Accept USDA's decision.

SIGNATURE: /s/ David A. Ivie

TITLE:

DATE: October 12, 1976

TO BE COMPLETED BY PLANT PROTECTION AND QUARANTINE PROGRAMS

PERMIT

Under authority of the Federal Plant Pest Act of May 23, 1957, permission is hereby granted to the applicant named above to move the soil described, subject to the following conditions:

1. To be shipped in sturdy, leak-proof containers.
2. To be released without treatment at the port of entry.
3. To be used only for herbicide analyses and only in the laboratory of the permittee at Kelly Air Force Base, Texas.
4. All unconsumed soil, containers, and effluent to be incinerated or autoclaved by permittee at conclusion of project.
5. Purified extracts may be moved to other laboratories without further restrictions.

PERMIT NO.: S-1805

VALID: THROUGH OCTOBER 31, 1978

NO. LABELS ISSUED: 50 PPQ Form 550

SIGNATURE OF PLANT PROTECTION AND QUARANTINE OFFICIAL: Jack E. Lipes (signed) Jack E. Lipes

DATE: October 18, 1976

PPQ FORM 525
JUNE 1975

REPLACES PPQ FORM 525 (7/74) WHICH MAY BE USED